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OTOLOGY

A Chair-based Abbreviated Repositioning Maneuver (ChARM) for fast treatment of posterior BPPV

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Abstract

Purpose To assess the effectiveness of a variation of the Epley maneuver, which we have titled "Chair-based Abbreviated Repositioning maneuver (ChARM)", in solving cases of benign positional paroxysmal vertigo (BPPV) of the posterior canal. ChARM addresses multiple issues of highly overloaded medical centers that delay its due and timely resolution. For example it does not necessitate an examination bed/table and requires only a backed chair, and less than 3 min to be performed. In combination with a recently published abbreviated diagnostic maneuver it can solve BPPV cases within few minutes of single medical visit.

Methods Patients being diagnosed with posterior BPPV by means of an abbreviated diagnostic maneuver were recruited. Immediately after diagnosis, a single attempt of ChARM was conducted. The patient was followed for 48 h and at 1 month after these procedures to assess the persistence of symptomatology.

Results 124 patients were treated with ChARM immediately after diagnosis during their very first medical visit. 92 patients (74.2%) solved their symptomatology completely after a single attempt of ChARM. The absence of symptoms persisted during the 30 days of follow-up.

Discussion ChARM showed high success rates in solving posterior BPPV. The entire diagnostic-treatment procedure takes less than 5 min to perform and may allow direct treatment of patients, thereby avoiding unnecessary referrals or full vestibular testing. These abbreviated tools may be particularly useful in primary care settings or heavily overloaded otolaryngology or neurology departments.

Keywords Benign paroxysmal positional vertigo · Repositioning maneuver · Vertigo · Dizziness · Nystagmus · Positional nystagmus

Introduction

Vertigo and dizziness are among the most common complaints in medical practice [1]. The single most common cause of these symptoms is benign positional paroxysmal vertigo (BPPV), a disease caused by the detachment and migration of otoconia from the utricle to a semicircular canal within the inner ear [2–5]. While the dislodged otoconia remains in the affected canal, the patient will suffer from brief vertigo spells when a change in head position causes the otoconia to move within the canal, creating a transient endolymph current and subsequent ampular flexion or deflexion, thus creating a signal of angular movement stronger and longer than the actual head rotation that occurred [4].

BPPV is very frequent with an estimated life prevalence of 2.6% and accounting for 20–50% of all vertigo or dizziness cases [3]. Due to its anatomical disposition, the posterior canal is the most commonly affected, given that loose otoconia tend to fall toward it during sleep [6]. Therefore, pcBPPV accounts for 80–95% of all BPPV cases [7].

Diagnosis of this entity can be easily reached through a Dix–Hallpike Maneuver, in which a vertigo spell and the

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characteristic nystagmus (partially up-beat, partially torsional toward the affected ear) are triggered by the maneuver [4].

The treatment for this disease is highly effective and consists of mechanical relocation of the detached otoconia back into the utricle, an objective achieved by repositioning maneuvers, such as the Epley and the Semont maneuvers [6, 8–10]. Such maneuvers have a success rate above 85% after a single attempt [10].

In sum, both the diagnostic Dix–Hallpike and the therapeutic Epley or Semont maneuvers can be conducted if a case of pcBPPV is suspected within a few minutes. Only a clinical bench/examination bed is required, thus resolving the disease immediately in most cases [4, 6].

Nevertheless, pcBPPV is often overlooked, misdiagnosed, and mishandled. Many patients wait several months or even years before the most common pathology in neuro-otology is properly diagnosed and treated [11, 12]. Different studies have reported that the average time from symptom onset to diagnosis can be as long as 19–70 months, requiring more than eight medical visits before a diagnosis of pcBPPV is achieved [13, 14].

The delay in diagnosis and treatment of pcBPPV has been attributed to many causes. There is a tendency in some settings to refer all cases of vertigo to otolaryngology, neurology, or vertigo-specialized units, which overload these centers [2, 12, 15]. Additionally, even in simple and uncomplicated BPPV cases, unnecessary imaging and vestibular testing are frequently ordered [12].

Many patients present to several different specialists before being laid on a clinical bench to perform a Dix–Hallpike Maneuver. Even when the diagnosis is reached appropriately, patients are usually referred to a physical therapist (on a different visit to a medical center) to conduct repositioning maneuvers, thus prolonging the time between onset, diagnosis and definitive treatment of pcBPPV [13, 14].

It has been proposed that a main issue behind this behavior lies in the lack of knowledge regarding BPPV among general practitioners and even otolaryngologists and neurologists. While the array of differential diagnosis for these patients is vast (including BPPV affecting lateral, anterior or a combination of multiple semicircular canals, central positional nystagmus and vestibular migraine, among others), the fact that the immense majority of cases are simple pcBPPV is forgotten and referral or imaging for discarding severe neurological disorders appear to be safer and more appealing. Therefore, the necessity of distinguishing between "the simplest and more frequent vertigo patient" (mainly pcBPPV, which may require a succinct set of clinical skills) and other vertigo patients (requiring more clinical knowledge and perhaps reasonable referral) arises.

On the other hand, in many settings, particularly in overloaded primary care facilities and even in many otolaryngology practices, the physician does not have ready access to an examination table or clinical bed to perform diagnostic positional testing such as the Dix–Hallpike or therapeutic repositioning maneuvers as the Epley maneuver. Therefore to refer the patient to further vestibular testing can be more appealing.

In an attempt to address these issues, an abbreviated version of the Dix–Hallpike diagnostic maneuver (abbreviated posterior canalolithiasis chair-based assessment maneuver, or APCCAM) was recently developed and tested for pcBPPV [16]. The APCCAM diagnostic maneuver has had wide acceptance among the medical community, mainly given that it can be performed in a simple backed chair (not even moving the patient from the chair he is being interviewed in). With an overall sensitivity of 80% and a specificity of 95% when compared with the classical Dix–Hallpike maneuver as the gold standard, APCCAM has proven to be an excellent tool to accelerate the handling of pcBPPV as a screening procedure.

It is important to state at this point, that APCCAM is not intended, by no means, to replace classical positional testing. This abbreviated screening-like procedure is performed without any form of gaze-fixation removal (such as Frenzel goggles, videonystagmography or video-oculography), and the final position of the head is significantly less "hanging" that the one achieved in Dix–Hallpike. These issues account for the 20% false negative results of its application. The clinical usefulness of APCCAM relies in the concept of it being a screening procedure and not a definitive test to rule out the presence of BPPV.

On the other hand, APCCAM does not, by itself, distinguish between pcBPPV and other forms of positional vertigo/nystagmus such as lateral, anterior or multiple canal BPPV, or central positional vertigo/nystagmus. Even a cupulolithiasis form of pcBPPV cannot be immediately identified by the simplified criteria proposed in the APCCAM original article [16]. This issue is addressed by the notion that a pcBPPV patient identified by APCCAM would have his symptomatology solved after proper repositioning maneuvers. If repositioning maneuvers fail to completely solve the patient's complaints, a disease different than the canalolithiasis variant of pcBPPV should be suspected and managed in accordance to common practice. Again APPCAM algorithms should be understood under a screening philosophy, as a step prior to common neuro-otological assessment of vertigo patients, thus accelerating management and decompressing overloaded healthcare facilities.

All things considered, and given the high frequency of pcBPPV, even with a 20% rate of false negativity, it is very compelling that 8 of every 10 pcBPPV cases can be immediately diagnosed without even moving the patient from his chair and promptly sent to repositioning maneuvers, avoiding unnecessary referrals and testing.

Along the same line as APCCAM, we have now developed an abbreviated treatment maneuver for pcBPPV. The purpose of the following study is therefore to present this new maneuver, which corresponds to a modified version of the Epley Repositioning Maneuver for the treatment of the posterior canalolithiasis form of Benign Positional Paroxysmal Vertigo (pcBPPV), which can be performed with the patient sitting on a chair (without requiring an examination bed) and which we have named "chair-based abbreviated repositioning maneuver" (ChARM).

Materials and methods

Between March and July of 2017, ChARM was developed by the authors. As will be evident from the description and images of ChARM, the maneuver is a variation of the classical Epley maneuver, replacing the examination bed with a backed chair. We have chosen to emphasize certain intermediate positions that have been suggested to enhance the efficacy of the Epley maneuver [7–9, 11, 17, 18]. After our first attempts at developing ChARM and after closely examining the nystagmus evoked in each position (indirectly indicating the relevance of each step in the migration from otoconia back to the utricle), we believe that these intermediate positions are key to a successful ChARM.

The description of the maneuver can be found in the legends of Figs. 1, 2, and 3, where we describe each of the nine steps of the maneuver. Following recommendations from the literature [7, 10, 18, 19], we propose to wait at least 20 s (and if symptoms are triggered during the maneuver, to wait 20 s after such symptoms subside), in each step from step C to step I (with steps A and B being only preparatory). Additionally, we have uploaded demonstrative videos with a healthy volunteer (written and informed consent was obtain from the participant) to the following link: (https://youtu.be/q9pDgqW5yFs).

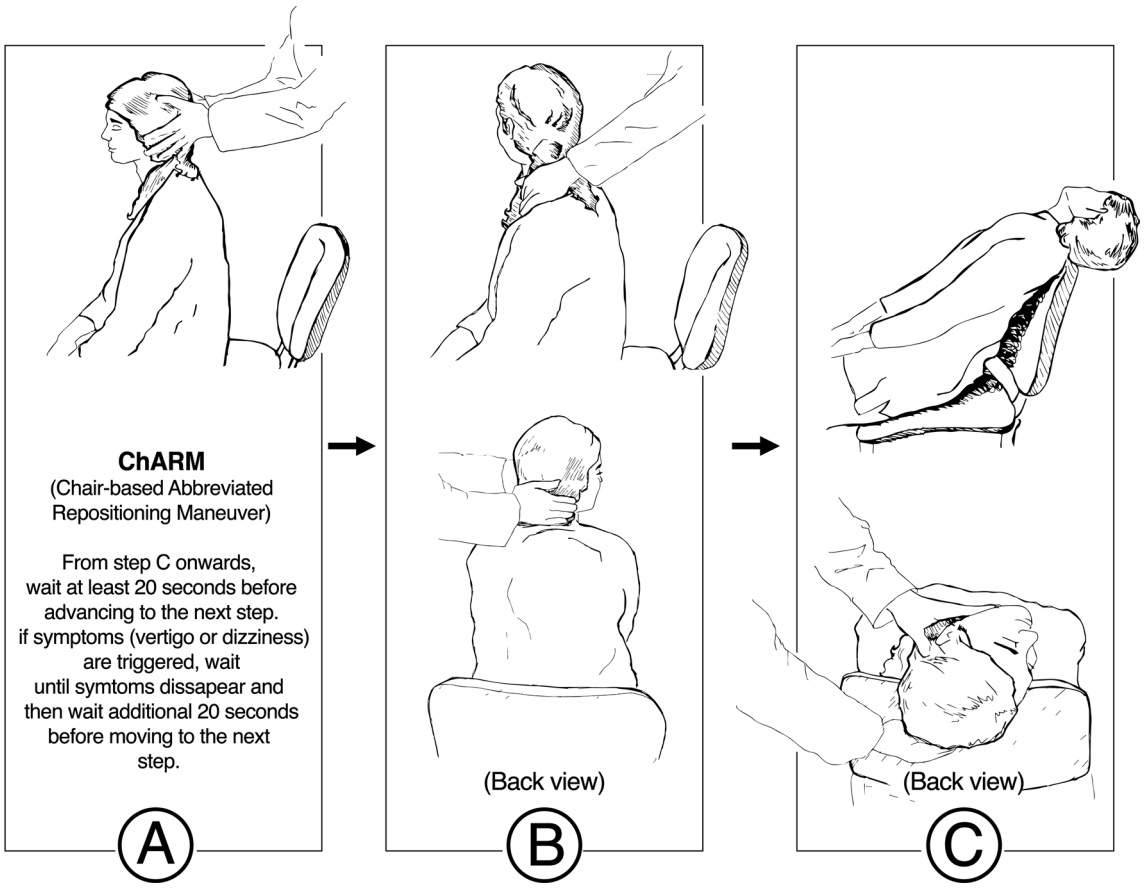

Fig. 1 ChARM: Steps **a**–**c**. The three initial positions of ChARM are presented. **a** The patient sits on the front edge of a backed chair. This setting is fundamental for achieving a good "head-hanging" position in further steps when the patient lays back. **b** The patient turns his head 45° toward the affected ear, thus aligning the afflicted posterior canal with the mid-sagittal plane of the rest of the body. **c** The patient is laid backwards, leaning his head in a 45° turned-head hanging position. The velocity of step C is not relevant. The key issue is to lay the head as backwards and as hanging as possible. Steps **a**–**c** are also the steps for the abbreviated diagnostic maneuver APCCAM to identify pcBPPV [16]. Furthermore, these steps attempt to imitate the first head-hanging position of a classical Epley maneuver

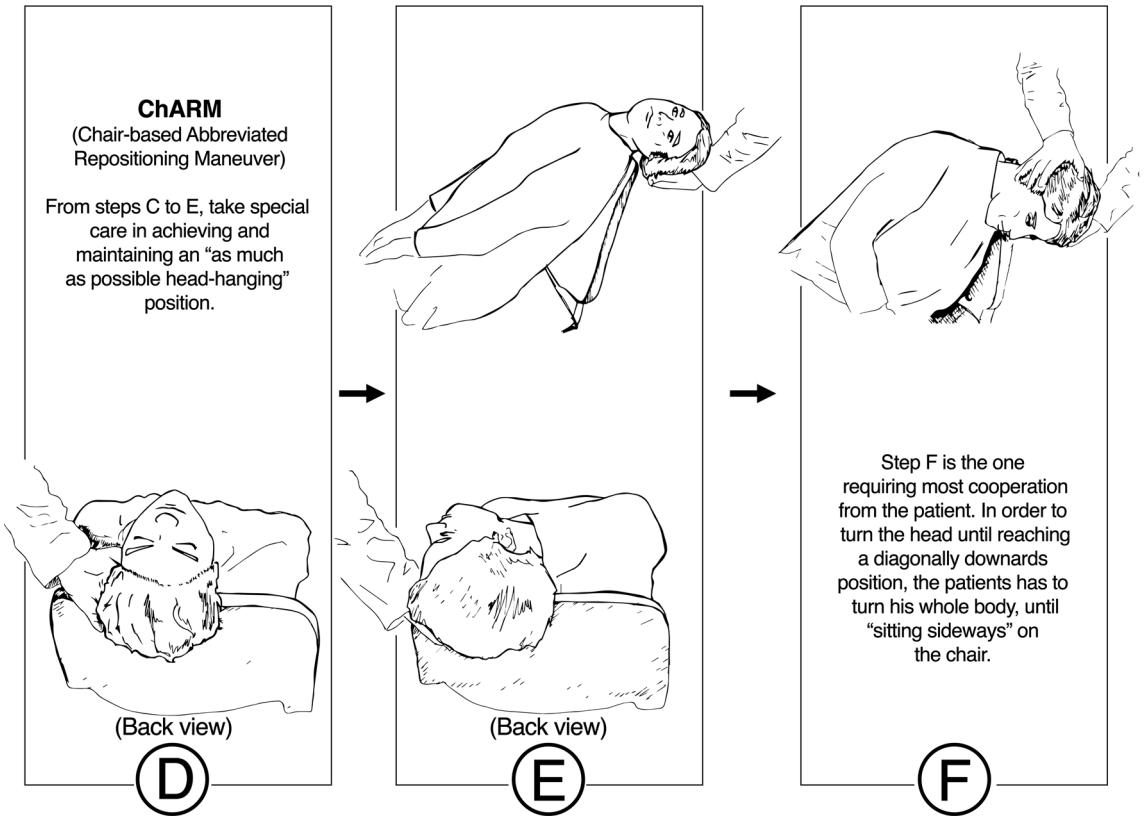

Fig. 2 ChARM Steps **d**–**f**. The next three positions of ChARM are presented. **d** Turn the head toward the healthy ear 45° until the head is hanging in a "middle position" with the patient looking towards the ceiling. We consider this intermediate position (in relation to classical Epley positions) to be critical to avoid an unwanted elevation of the head, which could return the dislodged otoconia toward the ampulla within the ampular arm of the posterior semicircular canal. Therefore, maintaining the head "hanging as much as possible" at all times is important. **e** Continue the head rotation toward the healthy ear another 45°, reaching a "specular" position as that of position (**c**). This step is analogous to the second head-hanging position of the Epley maneuver. **f** This is perhaps the step requiring more collaboration from the patient. The patient must turn his whole body sideways toward the healthy ear. Simultaneously, the head has to turn a further 90° reaching an oblique position, looking diagonally toward the floor. This position is analogous to the third position of the Epley maneuver

Between August 2017 and August of 2018, an initial applicability study, attempting to explore the applicability, real-life behavior, and effectiveness of ChARM, was conducted in the otolaryngology department of Hospital San Juan de Dios in Santiago de Chile, an overloaded tertiary referral center in general otolaryngology (not specialized in vestibular disorders) belonging to the Chilean public health system and associated with the Universidad de Chile's Medical School. Here, four otolaryngology residents and one staff otolaryngologist applied the maneuver. All physicians where properly trained in ChARM, and all of them had previous experience with the APCCAM diagnostic maneuver [16]. The study was approved by the ethics committee of the Universidad de Chile's Medical School. As an initial exploration of applicability and effectiveness of the technique, and having no prior estimation of its success rate, no required sample size was calculated.

Patients were recruited during their first medical interview with physicians participating in the study. If dizziness or vertigo was the chief complaint and the clinical history was suggestive of BPPV, APCCAM was conducted without any means for gaze-fixation removal, as described in its original publication [16]. An abnormal APCCAM test (resulting in the diagnosis of pcBPPV by means of unilaterally triggered nystagmus or unilaterally triggered symptoms) was considered as our main inclusion criteria. We are aware of a circa 20% false-negative ratio for pcBPPV relying in APPCAM alone for diagnosis. We chose this approach to simulate a scenario as close as possible to our screening-like algorithm for patient management (see Fig. 4 and related comments on the discussions segment). We emphasize that patients with a negative APCCAM result would continue standard management, including Dix–Hallpike testing. For this study we did not record data regarding patients who later proved to have pcBPPV with initial negative APCCAM testing.

As exclusion criteria, we eliminated pediatric patients (under 18 years old), patients having a history or clinical

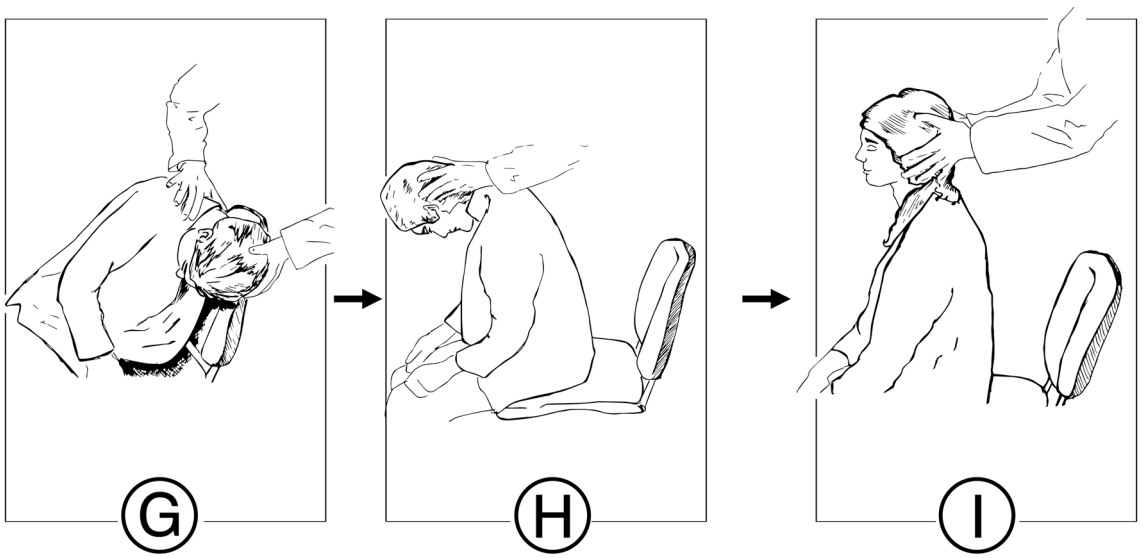

Fig. 3 ChARM Steps **g**–**i**. The final three positions of ChARM are presented. **g** Before sitting up to the starting position, patients are instructed to put their chin against their chest. A "chin to the chest" head position while sitting up, attempts to move the otoconia from the common crux toward the most anterior portion of the utricle. Incorporating this intermediate step has been proposed to increase the chance of success of the Epley maneuver, and we consider this a critical contribution for ChARM. **h** The patient sits again, but maintaining their head downwards, as a continuation of the "chin to the chest" position. **i** The patient lifts his head, returning to the initial position and concluding ChARM

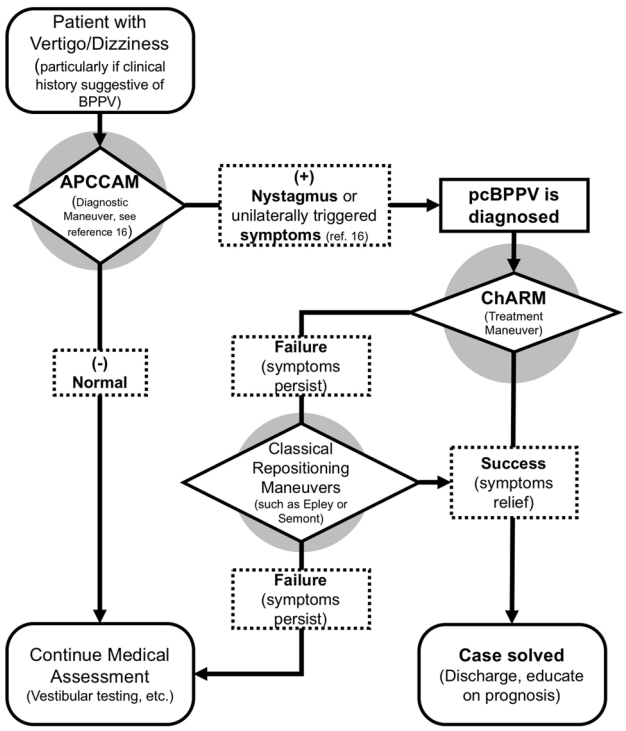

Fig. 4 Conceptual algorithm emphasizing the potential role of ChARM. Given the high prevalence of pcBPPV as the leading single cause of vertigo, identifying it through APCCAM and then treating it by means of ChARM may lead to an effective management solution, avoiding unnecessary referrals or testing. If APCCAM or ChARM fails, the patients should continue their medical management as usual

examination suggestive of other associated neuro-otological disorders or phenomena (such as vestibular neuritis, vestibular migraine, Ménière's disease, spontaneous nystagmus, etc.), thus attempting to focus on "pure" BPPV cases.

When pcBPPV was identified by means of APCCAM in these patients, they were asked to participate in the study, and informed consent was obtained.

Then, within the same first medical visit, a single attempt of ChARM was performed in the same chair where the interview and APCCAM were conducted. Patients were instructed to contact the research team in case of new spells of vertigo or dizziness after this treatment.

Moreover, the patients were contacted 48 h and 30 days after the first medical visit as follow-ups to assess the disappearance or persistence of dizziness or vertigo. Patients were asked if they were completely symptom-free and if they have recovered their previous health status, including not needing to avoid triggering positions. The ChARM treatment was considered successful if no symptoms appeared 30 days after the first medical visit. If symptoms reappeared at any point, failure of ChARM was determined and patients were scheduled for classical repositioning maneuvers with therapists of the otolaryngology department.

Results

In total, 136 patients were recruited. In all cases, ChARM was applied during the first medical visit without complications. No patient reported pain or any discomfort during the maneuver. We were unable to contact 12 of these patients 30 days after their first visit, leaving 124 patients for analysis. The mean age was 58.8 years old, ranging 21–88 years of age, with a 15.3 year standard deviation. The majority of our patients were female (75.9%).

92 of the initial 124 patients (74.2%) reported complete recovery of symptoms after a single attempt of ChARM. They continued to report the absence of vertigo spells at their 48-h and 30-day follow-up.

The remaining 32 (25.8%) patients complained of persistence of their vertigo spells after their initial visit. 21 reported it spontaneously on the day after ChARM was conducted, and the rest commented on it at their 48-h follow-up. All 32 patients were scheduled for classical repositioning maneuvers. The Epley maneuver was performed on all cases. All patients experienced total relief of symptoms after this treatment. Eighteen patients required a single Epley maneuver. Ten patients required two sessions of the Epley maneuver, and four patients required three sessions with multiple Epley and Semont maneuvers to recover.

We found no statistically significant difference between patients having a successful response to ChARM and those who required subsequent Epley or Semont maneuvers, in terms of age or gender distribution. We did not reliably record time between symptoms onset and ChARM in all patients, and thus avoided to analyze this variable. We observed no lateral or anterior BPPV in these 124 patients. We also did not encounter cases of central positional vertigo.

Altogether the immediate success rate of ChARM after a single attempt was 74.2% and the benefit lasted at least 30 days after application.

In all patients who experience a failure of ChARM, standard treatment could be conducted without further delays or complications, leading to total recovery from BPPV.

Discussion

ChARM appears to be a highly successful, easy-to-perform, rapid and simple therapeutic option for pcBPPV that can be performed in the same chair on which a patient is interviewed during his first medical visit.

We acknowledge that a 74.2% success rate is lower than that of the Epley or Semont repositioning maneuvers, which ranges up to 85% on a single attempt [10, 11, 20], but is far larger than we initially expected.

Nevertheless, it has never been the intention for ChARM to replace classical repositioning maneuvers such as the Epley or Semont. Rather, the spirit behind both APCCAM and ChARM is to offer an additional tool for clinicians in overloaded settings or lacking the time or opportunity to conduct diagnostic or therapeutic maneuvers in a clinical bed. These abbreviated maneuvers are thought to be part of a "screening" procedure for identifying and readily treating the single most frequent cause of vertigo and dizziness. In the worst-case scenario, patients in whom APCCAM fails to identify pcBPPV or in whom ChARM fails to treat the diseases will continue with their medical management as usual. We summarize our proposal for a pcBPPV management algorithm in Fig. 4. We believe that this algorithm also helps conceptually distinguish the "simplest and also most frequent cause of vertigo" from other more complex causes in terms of patient management. This simplification may lead to promote the awareness of pcBPPV among general practitioners, hopefully encouraging them to assess and treat opportunely this entity instead of referring it.

In patients for whom both APCCAM and ChARM are successful, pcBPPV will have been treated within the first medical visit, without further and unnecessary referrals or testing. If we consider the 80% sensitivity of APCCAM [16] and the 74.2% success rate of ChARM, theoretically, 59.4% of all pcBPPV patients can be treated by means of this abbreviated algorithm within a single medical encounter.

We acknowledge several limitations within this study, which must be considered carefully when interpreting our findings. Given that the present study was an initial assessment of ChARM's applicability, our design lacked a control group, where no treatment or standard treatment was administered. This limits importantly the estimation of the actual efficacy of ChARM. Nevertheless, all our patients reported symptoms up until the day of intervention, and those in which ChARM was declared to be successful, reported complete relief of symptomatology from that very day on. We feel that this timing between symptomatology relief and the application of ChARM, while not being absolutely reliable, is robust enough.

We are quite surprised with the high success rates of ChARM reported in our findings, and now consider that perhaps this technique does require comparison with standard treatment (Epley) as a control group, in a future effectiveness study. At the time being, we preferred to publish this preliminary results as they are here, as initial presentation of the ChARM technique.

Another issue is our definition of pcBPPV resolution. We did not repeat APCCAM or Dix–Hallpike tests to check for persistence of BPPV associated nystagmus, and relied exclusively in patients' symptomatology reports. For many clinicians and researchers this post-repositioning testing is essential. We feel otherwise, that it is the absence

of symptomatology what defines recovery, particularly given the reports of an as large as 9–10% finding of positional nystagmus in the absence of symptomatology in not only elderly but also young healthy populations [21, 22]. In our understanding, it is possible to find canalolithiasis-related positional nystagmus in healthy subjects without a clinically significant BPPV disease. Perhaps we should speak of "clinically burdening pcBPPV" instead of just pcBPPV in regard to our APPCAM-ChARM approach, as we believe that it is the presence of symptomatology what defines the relevance of this illness.

We also want to address explicitly the limitation not of the study's design, but of APPCAM, to immediately identify lateral, anterior or multiple canal BPPV, as well as central positional nystagmus/vertigo. The identification of these entities depends of the failure of ChARM/persistence of symptomatology after treatment and subsequent completion of standard clinical assessment. Therefore we feel important to state that if ChARM fails it should not be repeated. While in simple pcBPPV cases, a second ChARM could indeed solve the issue, to systematically recommend the repetition of ChARM in case of initial failure, could indeed conduct to a delay in the diagnosis of other causes of vertigo.

Altogether we considered our results as a first presentation of the ChARM technique, with an initial assessment of its effectiveness. Further studies, with larger samples, comparing ChARM with immediate Epley application, and analyzing more detailed differences between success and failure groups (severity and duration of symtpoms, number of Epley maneuvers needed to solve BPPC, etc.) are required to have a better assessment of ChARM effectiveness.

Moreover, the actual impact of an APCCAM-ChARM protocol on patient referral rates, numbers of tests ordered, and daily activities of medical centers that treat patients with vertigo (including primary care centers, emergency departments, and vestibular-specialized units) remain to be seen.

However, at least in this initial study, ChARM appears to be an effective tool that can treat the leading and most easily solvable cause of vertigo, pcBPPV, using a maneuver that can be easily taught and that requires only a backed chair.

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Compliance with ethical standards

Conflict of interest We declare no conflicts of interest regarding this manuscript.

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