Comparison between different repositioning maneuvers used for treatment of the lateral canal BPPV

Original Article

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ABSTRACT

Introduction and Objectives: Benign paroxysmal positional vertigo (BPPV) affecting the lateral semicircular canal is a common condition characterized by vertigo triggered by head movements. This study aimed to compare the efficacy of different repositioning maneuvers for geotropic and apogeotropic lateral canal BPPV variants, determining the required sessions for symptom remission.

Patients and Methods: A randomized clinical trial included 84 patients with lateral canal BPPV treated at a medical center. Patients were divided based on BPPV variant and underwent specific repositioning maneuvers. Outcome measures included direct remission and timing of symptom resolution. Statistical analyses were performed to compare outcomes between different maneuvers in both geotropic and apogeotropic variants of lateral SCC BPPV.

Results: Showed varying success rates among maneuvers for different BPPV variants. The Gufoni maneuver was most effective for geotropic BPPV, while the Zuma maneuver showed high efficacy for apogeotropic BPPV.

Conclusion: These findings provide insights into maneuver effectiveness and may guide treatment decisions for lateral canal BPPV.

Key Words: Benign paroxysmal positional vertigo, lateral canal, Nystagmus, repositioning maneuver, Zuma maneuver.

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INTRODUCTION

Benign paroxysmal positional vertigo (BPPV) of the lateral semicircular canal is a well-known condition seen in dizziness clinics. Lateral canal BPPV is the second most common type of BPPV following the posterior canal representing 5 to 22% of the cases[1].

The condition is characterized by short, repeated attacks of vertigo triggered by change in the head position relative to gravity. It especially occurs when looking up, turning in bed, or straightening up. Also, the LC-BPPV may mimic an acute vestibular syndrome as it may cause strong and prolonged vertigo[2, 3].

The canalithiasis or the geotropic variant of the lateral canal BPPV is due to the freely floating otoconia in the non-ampullary arm of the lateral canal. Apogeotropic variant of the lateral canal BPPV is caused by free floating otoconia in the ampullary arm or cupulolithiasis with the debris deposited in the utricular side of the LC[4, 5]. As the semicircular canals are the sensors of angular head acceleration. In canalithiasis, if a critical mass of otoconia is present within a given canal, the gravitational movement of the otoconia with head movement will cause abnormal endolymph flow, giving a false sensation of head movement with vertigo and nystagmus. The cupula normally is equal in density to the surrounding endolymph and thus does not exert a force on the hair cells when the head is stationary. The attached otoconia produce a density difference causing gravity-dependent movement of the cupula[6].

Diagnosis of lateral canal BPPV is done through supine roll test during which the patient lies 30 degrees to bring lateral canals in horizontal plane then turning the head about 90° to each side. In case of geotropic variant the side with the stronger nystagmus is the affected side while in apogeotropic variant the side with weaker nystagmus is the affected side. The mechanism of this finding is explained by Ewald's second law, which postulates that the response to an excitatory stimulus is always more intense than to an inhibitory stimulus[7]. Although the main way for diagnosing the side of lateral canal affected is through comparing the strength of nystagmus on both sides in supine roll test (McClure-Pagnini test) as mentioned earlier. Sometimes it is confusing to estimate which side is affected. There are some tests that would help in secondary signs of lateralization to diagnose the affected side. First the seated supine positioning testing (SSPT) where the patient is brought briskly from seated to supine position with 30o head flexed. In this position in the geotropic variant the otoconia in the posterior arm

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will cause an ampullofugal inhibitory endolymphatic flow with a nystagmus beating towards the unaffected side. On the other hand in apogeotropic variant the otoconia will cause an ampullopetal excitatory endolymphatic flow with nystagmus beating towards the affected side[8].

Also, the bow and lean test or the head pitch test, where the patient is in sitting position with bow position; forward head bend 90 degrees and lean position bringing the head backwards 45 degrees. In geotropic variant the nystagmus is stronger in bow position and nystagmus beats towards the affected side while in leaning the nystagmus beats towards the unaffected side. Vice versa in apogeotropic variant[9].

Thirdly the Pseudosponteanous nystagmus (PSN) which is differentiated from the true spontaneous nystagmus by HPT. Forward head bend 30o brings the LC aligned in respect to the horizontal plane resulting in null point with stoping the nystagmus. Bending the head forward 60o causes reversing the nystagmus while extension of head 30o increases its intensity. In geotropic variant the particles flow away from the ampulla and cause a nystagmus beating toward the unaffected ear. On the other hand, in apogeotropic LC-BPPV, the particles flow toward the ampulla and therefore the nystagmus beats toward the affected ear[9].

Pseudo-Spontaneous Nystagmus: a new sign to diagnose the affected side in Lateral Semicircular Canal Benign Paroxysmal Positional Vertigo[3].

Nowadays, different maneuvers have been proposed for treating both variants of lateral canal BPPV (geotropic and ageotropic variants)[10].

Even though there are controversies about the efficacy of each repositioning maneuver, based on recent guidelines, there is no preferred repositioning maneuver for the lateral canal cupulolithiasis nor the lateral canalithiasis BPPV.

Our purpose is to compare the efficacy of different repositioning maneuvers used to treat both geotropic and apogeotropic lateral canal BPPV and to determine the number of sessions required for each maneuver to achieve remission of symptoms.

PATIENTS AND METHODS:

This is a prospective randomized clinical trial study that was conducted at a tertiary-care medical center. It included 84 adults with lateral canal BPPV treated in our outpatient clinic from the interval from February 2022 to March 2024. Ethical approval was obtained from the Research Ethics Commission of our institution (IRB NO:00012098-FWA NO:00018699). All patients underwent otoneurologic examination including otoscopy, pure tone audiometry, tympanometry, and full videonystagmography tests battery. All patients underwent cerebellar bedside tests including (assessment of gait, heel to shin test, finger to nose test and rapid alternating test) to exclude any cerebellar affection.

The diagnosis was based on the supine head roll test to diagnose the affected side[7]. This diagnostic maneuver was used to avoid differences between groups. The diagnosis is based on the appearance of direction changing horizontal nystagmus on supine roll test whether geotropic or apogeotropic. If geotropic positional nystagmus is paroxysmal, transitory and fatigable patient is diagnosed as LC-BPPV geotropic variant. If patient had apogeotropic nystagmus that is persistent patient is diagnosed as LC-BPPV apogeotropic variant. Patients with multiple semicircular canals BPPV, including posterior or anterior canal BPPV, those with neurologic or psychogenic disease, or those diagnosed with other causes of peripheral or central vertigo were excluded from the study.

All patients diagnosed with lateral canal BPPV were divided into 2 groups; group 1 consists of 50 patients with the geotropic variant of lateral canal BPPV, group 2 consists of 34 patients with apogeotropic variant of lateral canal BPPV.

Patients in the first group with geotropic variant of LC-BBPV were further subdivided randomly into 3 groups group A included patients treated with Guffoni maneuver, group B consisted of patients treated with Appiani maneuver and group C consisted of patients treated with the BBQ barbecue (Lempert) maneuver.

In the Gufoni maneuver, the patient starts in an upright sitting position with the head neutral. Then, the patient is rapidly tilted to the non-affected side. Then, the examiner quickly turns the patient's head downward by 45° (nose down). Finally, after 2 to 3 minutes the patient is returned to the sitting position[11].

While in the Appiani maneuver, the patient starts also in a sitting position with the head in neutral. Then, the patient is tilted to the unaffected side and remains in this position for 2 minutes. The therapist turns the patient's head to the side opposite to the affected side so that his face is facing downwards. The patient remains in this position for 2 minutes[12].

On the other hand, in Lempert`s (barbque roll) or log roll maneuver: the patient starts by lying on the affected side. Then, the patient is brought through 90 degrees head/body turns towards the good/healthy side. So after attaining the first position the patient is rolled to supine then affected ear up then keep rolling in the same direction until patient's head is completely nose down or prone then to sitting position. The interval in each position is 30 seconds to 1 minute or till the nystagmus stops. At the end the patient's head and body is turned through 270-360 degrees[6, 13, 14].

Second group of patients with ageotropic variant of LC-BPPV was further subdivided into 3 groups; group A2 consisted of patients treated with Gufoni maneuver, group B2 consisted of patients treated with Casani maneuver and group C2 consisted of patients treated with Zuma maneuver.

In Casani Maneuver, The patient starts in a sitting position with the head in neutral. Then, the patient is moved into a side-lying position towards the affected side. Then the patient's head is turned to the affected side by a passive 45˚downward movement so that his face is facing downwards. The patient remains in this position for 2 minutes[15].

In Gufoni maneuver for the apogeotropic variant of the LSC-BPPV, the patient starts by lying quickly on the affected side (side with weaker nystagmus) for 2 minutes. Then, the examiner turns the patient's head quickly 45 degrees (nose up) for 2 minutes[15].

In the Zuma maneuver, the patient starts in the sitting position. Then, the patient lies down quickly on the affected side (step I) for 3 minutes. Then, his head is rotated 90° toward the ceiling (step II) for another 3 minutes. After 3 minutes, the patient moves the body into dorsal decubitus and the head is turned 90° toward the unaffected side (step III) and held in this position for another 3 minutes. Finally, the patient's head is tilted slightly forward (step IV), followed by sitting slowly (step V)[16].

All patients of both first and second group were seen one week later after the first maneuver and were tested with supine roll test. All patients were instructed not to sleep on the affected side for 2 consecutive days. No vestibular suppressants were used before and after the therapeutic maneuver.

Statistical methods

The primary outcome for this study is direct remission. In addition, a new composite outcome variable was created based on patients' direct remission for those who performed one maneuver and achieved the outcome in less than 2 days.

Quantitative data were described by mean and standard deviation; median, range and interquartile range while categorical data were summarized by frequency, percent, and bar chart as appropriate. Chi-square test (X2) assessed a significant association between two categorical variables. Fisher exact (FEp) and Montecarlo significance (MCp) were performed if more than 20% of total expected cell counts <5. Independent sample t test as well as Kruskal-Wallis test were performed to compare the mean and median age between different types of maneuvers and outcome based on normal distribution of variables by Kolmogorov Smirnov test (Field, A. (2013) Discovering statistics using IBM SPSS statistics (4th ed.). SAGE Publications.

Relative risk was calculated to compare incidence of direct remission among alternative maneuvers, with respective 95% confidence interval.

All statistical tests were conducted using IBM SPSS statistics program version 29, and R software packages at .05 significance level. (IBM Corp. Released 2021. IBM SPSS Statistics for Windows, Version 29.0. Armonk, NY: IBM Corp.)[17].

RESULTS:

During the study period of 2 years, 84 patients with LSC BPPV were enrolled for repositioning therapeutic maneuver. 50 patients were diagnosed with the Geotropic variant of the LSC BPPV (30 Females and 20 Males) with a mean age of 47 (42.75±12.3). Only three patients of them had a history of head trauma.34 patients were diagnosed with the apogeotropic variant of the LSC BPPV (19 Females and 15 Males) with a mean age (47.56±13.175). Duration of symptoms in the studied patients ranged from 1 day up to 1 month.

As regarding the first group with the geotropic variant LSC-BPPV. 22 patients were treated with the Appiani maneuver, 21 with the Gufoni maneuver and only 7 patients were treated with the BBQ maneuver. Most patients required single time maneuver for complete direct remission (88%) with only 6 patients required 2 maneuvers with 1 week interval to reach complete remission (4/22 with Appiani and 2/7 for barbque manueuvers).

We assumed that best possible outcome is direct remission with only one repositioning maneuver within less than two days. The best possible outcome was achieved for 14/22 patients treated with the Appiani maneuver (48.3%), 10/22 patients treated with Gufoni maneuver (34.5%), 5/7 treated with the BBQ maneuver (17.2%). (Figure 1)

As regarding the second group of patients with the apogeotropic variant of the LSC-BPPV, ten patients were treated with the Casani maneuver, 14 patients were treated with the Gufoni maneuver and 10 patients with the Zuma maneuver.

3/10 patients treated with the Casani maneuver, 3/14 patients treated with Guffoni maneuver and 1/10 patients treated with Zuma maneuver needed two therapeutic maneuvers for complete remission. (Figure 1) denotes the outcome of each therapeutic maneuver used within one week.

We assumed that best possible outcome is direct remission with only one repositioning maneuver within less than two days. The best possible outcome was achieved for 3/10 patients treated with the Casani maneuver, 2/14 patients treated with Gufoni maneuver, 6/10 treated with the Zuma maneuver (Figure 2).

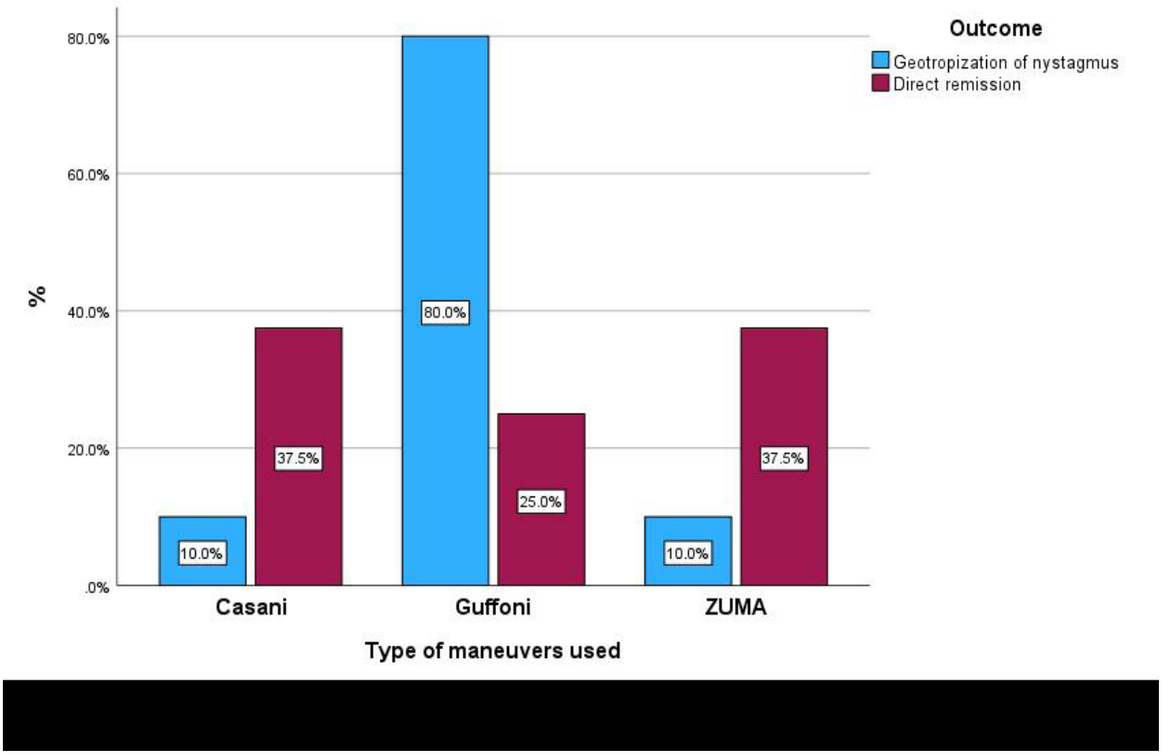

Fig. 1: Outcome of the group with the geotropic variant of LSC-BPPV with each repositioning manuever

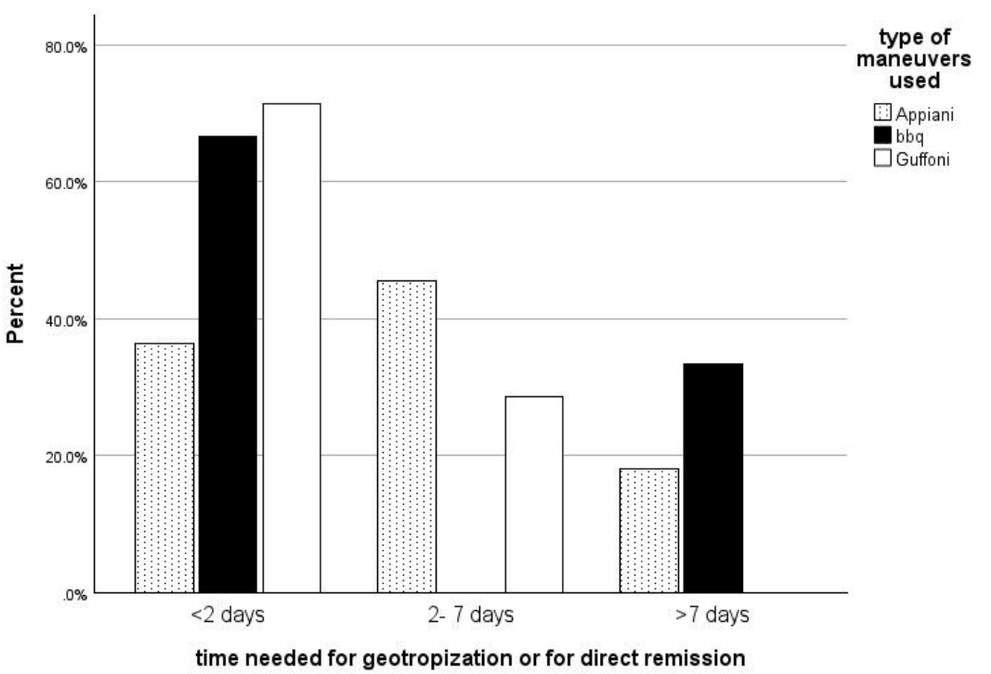

Fig. 2: Denote the outcome of each therapeutic maneuver used within one week.

DISCUSSION

The main concept in treatment of lateral canal BPPV is to remove the otoconia from the semicircular canal and move them to the vestibule. It is well known that the geotropic variant pf LSC-BPPV is more responsive to repositioning maneuvers than the ageotropic variant[18, 19].

The angular acceleration, sudden linear acceleration or the slow gravitational sedimentation are the main mechanism for removing the otoconia from the SCCs. Barbecue roll and Gasani repositioning maneuver is based on the angular acceleration. On the other hand, Appiani and Zuma maneuvers are based on the slow gravitational sedimentation (forced prolonged positioning). While Gufoni maneuver is based on the sudden linear acceleration[20].

The main concept is to detach the otolithic debris from the cupula or push the debris from the anterior into the posterior arm of the LSC[11].

Although BBQ maneuver had resolved many cases with geotropic variants of LSC BPPV, but it is not applicable in elderly with reduced mobility or overweight patients[11].

In this study, the BBQ maneuver was done for seven patients. All of these patients showed complete direct remission with single maneuver while 2 patients needed more then one maneuver. Multiple studies used Lempert`s maneuver and compared it to other maneuvers. Studies reported a success rate between (38.4% to 69.1%)[21].

The most used side-lying maneuver for geotropic horizontal canal BPPV was described by Ciniglio Appiani, *et al*.,[12]. In their earliest study, Appiani *et al* reported a success rate of 78% after one maneuver and 100% after two maneuvers. In our study 4 patients out of 22 needed more then one maneuver for complete remission[12].

The Appiani maneuver seems to be more effective for the geotropic variant of the LSCC or the canal-side debris than the ageotropic variant of LSCC or the utricular-side debris[22, 23].

On the other hand, the Gufoni maneuver was first described in 1998[11]. In this study, the success rate of the Gufoni maneuver for the geotropic variant of the LSCC was 100%. This agrees with our study, as all of the 21 patients treated with the Gufoni maneuver showed complete remission after single maneuver. Gufoni maneuver is based on the brisk deceleration inertia when the patient moves from the sitting position to the unaffected side and the rapid angular acceleration when his head is turned downwards. While the patient lies on his unaffected side, the LSC posterior arm is in the vertical plane associated with ampulofugal flow of the otolith. Turning the head downwards 45 degrees makes the outlet of the posterior arm of the canal in a vertical plane. Thus, facilitates otolith flow into the utricle[24, 25].

In our study, the Gufoni maneuver seems to be more effective for the geotropic variant of LSC or the utricular side debris than for ageotropic variant or the canal side debris which was in agreement with previous studies[22, 24, 26, 27].

As regarding the apogeotropic variant of LSC, one of the most commonly used side-lying intervention for the apogeotropic presentation of horizontal canal BPPV was described by Casani *et al* in 2002 which is a modification of Semont`s maneuver. In his study, Casani`s patients who were symptom free after three sessions accounted to approximately 90% of his entire study group[15].

In this study, the effectiveness of the Gufoni maneuver was very low for the ageotropic variant of the LSC which also was in agreement with previous studies. As only 3 patients out of 14 showed direct remission and 11 showed geotropization of the nystagmus. The relative risk beween the Gufoni maneuver for the ageotropic variant of LSCC and Casani maneuver was statistically significant (RR=0.47)[26].

Our results showed that the Zuma maneuver is more effective for treating apogeotrpoic variant of the LSCC with a success rate of 90 % (9 of 10). Although it did not show statistically better results than the Casani maneuver without vibration. The relative risk (RR) =1.

In 2016, Zuma maneuver was created as a therapeutic maneuver for the apogeotropic variant of the LSC-BPPV. It consists of a sequence of head positions to detach the otoconia from the anterior arm of the horizontal canal and/or the cupula. It depends on both inertial and gravitational forces to deatache and guide otoliths toward the utricle[16].

In this study, Zuma Maneuver showed a higher rate of success where 9 out of ten patients showed complete remission after a single maneuver. Zuma maneuver is based mainly on gravitational, rapid angular acceleration (gravity + inertia) without the need of another Gufoni maneuver in the case of geotropic transformation[16].

The Zuma maneuver has some advantages over other maneuvers. Like the Casani and Gufoni maneuver for ageotropic variant of LSCC, the patient is positioned on the affected side thus induces fewer vertiginous

symptoms. This position detaches otoconia from the cupula and moves them out of the lateral canal. Another advantage of this maneuver that it is easier to perform in obese elderly patients, patients with cervical spondylosis, or musculoskeletal deficiencies than the so-called barbecue maneuvers[16]. The Appiani maneuver demonstrated a favorable outcome for the geotropic variant, with a moderate success rate. In contrast, the Gufoni maneuver exhibited a higher success rate for this variant, indicating its efficacy in achieving complete remission. The BBQ maneuver, while effective for some patients, had limitations in its applicability, particularly in elderly individuals with reduced mobility or overweight patients.

For the apogeotropic variant, the Casani and Zuma maneuvers were explored alongside the Gufoni maneuver. The Zuma maneuver stood out with a notably high success rate for this variant 90% (9 of 10), emphasizing its effectiveness in achieving complete remission with a single maneuver. The study highlighted the advantages of the Zuma maneuver, including its ease of performance in various patient populations and its ability to leverage gravitational and inertial forces for optimal results.

A limitation of the current study that we did not follow up the patients after remission to assess the incidence of recurrence. It is recommended to conduct a follow study on a larger sample of patients to assess recurrence.

CONCLUSION

Overall, the study contributes valuable insights into the tailored management of different variants of LSC BPPV through specific repositioning maneuvers. Understanding the mechanisms behind each maneuver and their differential effectiveness in addressing otolithic debris within the semicircular canals sheds light on optimizing treatment strategies for patients with BPPV. Further research and comparative studies could provide additional evidence to enhance the management protocols for LSC BPPV, ultimately improving outcomes for affected individuals.

CONFLICT OF INTEREST

There are no conflicts of interest.

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