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REVIEW ARTICLE

A safe-repositioning maneuver for the management of benign paroxysmal positional vertigo: Gans vs. Epley maneuver; a randomized comparative clinical trial

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Abstract Benign paroxysmal positional vertigo (BPPV) is the most common cause of peripheral vertigo. Some repositioning maneuvers have been described for its management. The aim of this study was comparing the therapeutic effect of Epley and Gans maneuvers in BPPV. This randomized clinical trial was performed from September to December 2015. 73 patients with true vertigo diagnosed as BPPV enrolled the study. They randomly assigned in quadripartite blocks to modified Epley maneuver group (E) or Gans maneuver group (G). 1 day and 1 week after intervention, the objective and subjective responses to treatment were assessed. Statistical analysis was performed using the Chi-square test and regression model in the SPSS software version 21. Thirty patients enrolled each group with a mean age of 46.9 ± 13.4 (E group) and 46.7 ± 7.5 year (G group). 23.3 % of E group and 26.7 % of G group were men ($p = 0.766$). In E and G groups in the first day, subjective outcomes revealed 86.7 and 60 % rate of success ($p = 0.02$); and 86.7 and 56.7 % of patients exhibited objective improvement, respectively ($p = 0.01$). After 1 week, the subjective and objective outcomes revealed improvement among 70 % of E group and 46.7 % of G group ($p = 0.067$). The only complication with significant difference was cervical pain with a higher rate in E group (23.3 vs. 0.0 %, $p = 0.005$). These results revealed the similar long-term efficacy of Epley and Gans maneuver for the treatment of BPPV. Cervical pain was most frequent complication of Epley maneuver.

Keywords Benign paroxysmal positional vertigo · Repositioning maneuver · Epley maneuver · Gans maneuver · Efficacy · Complication

Introduction

Vertigo, with a prevalence of 5–10 %, is a common complaint of patients referring to neurology and otolaryngology clinics [1, 2]. Benign paroxysmal positional vertigo (BPPV), described by Barany in 1921, is the most common cause of true vertigo [3–8]. It is characterized by brief episodes of intense vertigo, provoked by changing position of head/neck, and typically accompanied by up-beating, torsional nystagmus with the superior pole of the eyes beating toward the affected ear. The symptoms are caused by the displacement of otoconia from the utricle to the semicircular canal and irritation of its cupula. Approximately 90 % of BPPV cases have the involvement of the posterior semicircular canal [4, 6, 8–11].

The most common cause of BPPV in people under age 50 is head trauma [12]. The head injury needs not to be direct, and even indirect injuries, such as whiplash injury, have a substantial incidence of BPPV [12]. BPPV becomes much more common with advancing age [13], and in older people, the most common cause is the degeneration of the vestibular system [14].

Pharmacological treatments are used for temporary control of BPPV and their discontinuation mostly results in

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recurrence of symptoms [8, 11, 15]. Fortunately, vestibular rehabilitation maneuvers, including Semont and Epley maneuvers, have been developed for treating the BPPV with a high rate of success [16, 17]. The goal of these maneuvers is to move the displaced otoconial debris around the long arm of the posterior semicircular canal, through the common crus, and back into the utricle using gravity and alleviating the symptoms of the patient. These maneuvers are claimed to be successful in approximately 80 % of cases [18–22]. The Semont liberatory maneuver (SLM) requires en bloc movement of the patient which involves a series of briskly performed position changes [16]. Unfortunately, the SLM is contraindicated for patients with orthopedic issues, such as recent hip replacements or hip fractures [6]. The Epley maneuver is also a successful method of treating BPPV which requires the rolling movement of the head, neck, and also the body of the patient [23] Epley maneuver and its modifications, collectively referred here as canalith-repositioning maneuvers (CRMs), are harmful in patients having limitation in cervical movement because of different orthopedic injuries and vertebrobasilar or carotid insufficiency which are more common among elders or patients with a past history of head and neck trauma. Here, it must be remembered that both older age and head and neck trauma are risk factors for developing BPPV [24]. Although these maneuvers have been argued having a success rate of 80 % after one treatment session and greater than 90 % after two sessions [24, 25], but obviously, older patients may exhibit factors that make it difficult to use either the Epley or the SLM for them [24]. Sakata et al. stated that the Epley or Semont maneuvers should never be performed in elderly patients [26]. For this reason, searching for a safer maneuver for treating PC-BPPV has been demanded. One of the safe hybrid treatments called the Gans-repositioning maneuver (GRM) is supposed to be equally effective or even superior to the previously introduced repositioning maneuvers [24]. Therefore, the purpose of this study was to determine the effectiveness of Gans-repositioning maneuver compared with Epley maneuver in BPPV patients.

Methods and materials

This randomized clinical trial was performed in the academic neurology and otology clinics affiliated to the Guilan University of Medical Sciences (GUMS) from September to December 2015. Its proposal was approved by research ethics committee of GUMS by code of IR.GUMS.-REC.1394.309 and registered in Iranian Registry of Clinical Trials (IRCT) by the number of IRCT20151109138N22.

Participants

To determine the required sample size, a pilot study was done on 20 patients with BPPV, who were assigned in Epley group (10 subjects) and Gans group (10 subjects). Based on the response rate 1 week after maneuver therapy (80 % in Epley group and 47.5 % in Gans group), $\alpha = 0.05$, $\beta = 20$ %, and the difference of 30 % and the power of 80 %, the minimum sample size in each group was calculated to be 30 cases. Allowing for 20 % loss to follow-up, we finally calculated a sample size of 36 cases in each group.

All participants in the study were patients with chief complaint of true vertigo referred to the neurology or otology clinics affiliated to GUMS. Informed consent was obtained from each patient prior to inclusion in the study. Participants were included in the study if they had a diagnosis of posterior canal BPPV. Diagnosis was made based on the patients' history of having true spells of vertigo for less than 1 min that revealed by the change of position of head and neck, especially in supine/recumbent position, having no other neurologic or otologic symptoms, and a positive result on the modified Dix-Hallpike test during vestibular evaluation. In the modified Dix-Hallpike, the examiner stands behind the patient, rather than to the side as is done in the traditional Dix-Hallpike. The examiner turns the head of the patient slightly toward the test ear and supports the patient's neck and back. This allows the examiner to sit, while the patient is lowered into the provoking supine position with the neck of the patient slightly hyperextended and supported, while his/her head is off the examination table. In this position, the examiner has a clear view of the eyes of the patient. This modification to the traditional Dix-Hallpike test resulted in enhanced ease of the performance of the maneuver for both the patient and the examiner [24]. The result was considered positive if there was a paroxysmal, up-beating rotary nystagmus toward the affected ear which had a short duration less than 45 s, along with a latency of onset and associated subjective vertigo upon administration of the maneuver. Seventy-three patients that met the inclusion criteria sequentially entered the study and randomly assigned in two groups of repositioning maneuvers in quadripartite blocks: the group receiving modified Epley maneuver (group E) or the group receiving Gans maneuver (group G). Severe systemic disorders that not allowed patients to cooperate in maneuvers, consumption of tranquilizers or anti-vertigo medications recently or during 1 week of follow-up, and not referring again for follow-up was considered as exclusion criteria. Special care was taken to ensure that the two groups were equivalent on several parameters (age, gender, side of involved ear, etc.).

Data gathering and intervention

All demographic and other vertigo related data were registered in a designed checklist which included age, gender, side of involvement, duration, and frequency of vertigo. Intervention was performed only by one investigator and assessment of the efficacy of the maneuvers was carried out by the other investigator who was blinded to the type of intervention. 1 day and 1 week after intervention, the objective and subjective responses to treatment by executing modified Dix–Hallpike maneuver were assessed. In addition, the major complications of treatment including the onset or aggravation of each grade of cervical and/or low back pain (even low grade in short time), increasing the frequency and severity of vertigo, and onset of nausea and vomiting were registered in two assessment time points.

Procedures

Epley-repositioning maneuver

In position 1, the patient was positioned supine, with the neck hyperextended and the affected ear down, while the clinician supported the head and neck. The patient was kept in that position for 1 min to allow the otoconia to move distal to the ampulla. In position 2, the head was rotated toward the opposite ear with the involved ear positioned upward for 1 min. This allowed the otoconia to settle at the common crus. In the third position, the patient was rolled onto the uninvolved side and kept in this position for 1 min. Finally, the patient was seated upright [23].

Gans-repositioning maneuver

The GRM incorporated the side-lying maneuver as its first position. This is similar to the SLM and avoids hyperextension of the neck that takes place in the canalith-repositioning maneuvers (CRMs). At first, the patient was in primary position seated and facing forward. Position 1: the head of the patient was turned 45° away from the affected ear, and the patient moved into a side-lying position on the involved side. Position 2: the second position was a roll from the involved side to the position 45° of uninvolved side. Otolith debris moves to common crus with this movement. After provocation of symptoms elicited by position 2, the patient instructed to shake head side-to-side three or four times. Position 3: finally, the patient was returned to an upright, seated position with head turned forward to central position. Otolith debris enters the utricle with this movement [24].

Following treatment with maneuvers, the patients were visited and rechecked with modified Dix-Hallpike positioning maneuver 1 day and 1 week later. This was performed to test for successful repositioning of the debris. Participants also provided a subjective report of their vertigo. The objective and/or subjective success of treatment were considered if no symptom and/or sign were present or provoked in visit times.

Data analysis

Prevalence ratios were calculated to compare baseline characteristics between Epley and Gans groups. Where appropriate; Chi-square or Fisher's exact tests were used to compare categorical variables. Regression model was used to produce odds ratios according to demographic variables with 95 % confidence intervals. Statistical analyses were performed using the SPSS version 21. p value less than 0.05 was considered as statistically significant.

Results

From seventy-three patients enrolled the study 13 patients were excluded according to the exclusion criteria, and 60 patients completed the survey: 30 patients in each group of Epley- and Gans-repositioning maneuver.

The E group ranged in age from 19.0 to 73.0 years (mean 46.9 ± 13.4) and consisted of 23 (76.7 %) women and 7 (23.3 %) men. The G group ranged in age from 33.0 to 65.0 years (mean 46.6 ± 7.5) and also consisted of 22 (73.3 %) women and 8 (26.7 %) men. The groups were equivalent in terms of gender and age ($p = 0.934$ and 0.766, respectively). In addition, they had been matched in terms of involved ear, duration, and prior occurrence of BPPV. Duration of vertigo ranged from 2 to 365 days in group E and 2 to 730 days in group G ($p = 0.633$). Six participants in each group had a history of prior episodes of BPPV ($p = 0.626$). Specific details about the groups are shown in Table 1.

Comparing the efficacy of repositioning maneuvers after 24 h

After one day of intervention by Epley maneuver, 86.7 % of patients ($n = 26$) showed subjective improvement, whereas 60 % of patients ($n = 18$) treated by Gans maneuver reported subjective response; the difference was statistically significant ($p = 0.02$). At this time, also objectively a significant improvement was found among Epley-treated group compared with the Gans group (86.7 %, $n = 26$ vs. 56.7 %, $n = 17$, $p = 0.01$) (Table 2).

Table 1 Demographic and clinical characteristics of BPPV patients participated in study

	Epley	GANS	Total	*p* value
Gender				
Male	7 (23.3 %)	8 (26.7 %)	15 (25 %)	0.766
Female	23 (76.7 %)	22 (73.3 %)	45 (75 %)	
Ear side				
Right	12 (40.0 %)	11 (36.7 %)	23 (38.3 %)	0.305
Left	10 (33.3 %)	15 (50.0 %)	25 (41.7 %)	
Bilateral	8 (26.7 %)	4 (13.3 %)	12 (20.0 %)	
Recurrence				
First episode	24 (80.0 %)	24 (80.0 %)	48 (80.0 %)	0.626
Recurrent	6 (20.0 %)	6 (20.0 %)	12 (20.0 %)	

Comparing the efficacy of repositioning maneuvers after 1 week

Results indicated that although the number of treated patients in Epley group was obviously more than the other group, there was no statistically significant difference between the groups in terms of subjective and objective outcome 1 week after intervention ($p = 0.067$). Twenty-one patients (70 %) in E group and 14 patients in G group (46.7 %) were free of vertigo and/or nystagmus associated with posterior canal BPPV (Table 2).

After 1 week, the objective recurrence rate of Epley and Gans maneuver group was 16.7 and 10 %, and subjective recurrence rate was 16.7 and 13.3 %, respectively. In E group and in 24 h follow-up, female gender (objective $p = 0.02$ and subjective $p = 0.042$), bilateral ear involvement (objective and subjective $p = 0.03$), and shorter duration of vertigo (subjective $p = 0.005$) were significantly related to responsiveness. In addition, the patients experienced the first episode of vertigo improved significantly by Epley maneuver rather than Gans maneuver in 1-day (objective $p = 0.023$ and subjective $p = 0.016$) and 1-week (objective and subjective $p = 0.017$) follow-up, while the recurrent vertigo did not show such improvement in any time of follow-up.

Logistic regression model was used to control the confounding effects. The results of bivariate analysis confirmed that the effects of being recurrent and its interaction by maneuver type were not significant, and Epley maneuver consistently remained more effective compared with Gans maneuver in follow-up after 24 h. Bivariate analysis indicated that the relative chances of subjective and objective responses to Epley maneuver rather than Gans after 1 day were 4.32 (95 % CI 1.2–15.6) and 4.97 (95 % CI 1.38–17.8) and after 1 week were 2.66 folds (95 % CI 0.92–7.69) (Table 3).

Complication of treatments

The results showed that the complications, such as increasing the frequency and severity of vertigo and onset of nausea and vomiting, were not significantly different between Epley and Gans groups. Although three patients in E group reported low back pain which was not reported in G group, but this difference was not significant ($p = 0.071$), whereas higher rate of cervical pain was observed in E group (23.3 vs. 0.0 %, $p = 0.005$).

Discussion

The present survey compared two methods of repositioning maneuvers for wearing off from the symptoms of benign paroxysmal positional vertigo. The statistical analysis revealed the higher subjective and objective response rate

Table 2 Comparing the response rates to Epley- and Gans-repositioning maneuvers

	Epley	Gans	Total	*p* value
Subjective response in 24 h	26 (86.7 %)	18 (60.0 %)	44 (73.3 %)	0.020
Subjective response in 24 h	26 (86.7 %)	17 (56.7 %)	43 (71.7 %)	0.010
Subjective response in 1 week	21 (70.0 %)	14 (46.7 %)	35 (58.3 %)	0.067
Objective response in 1 week	21 (70.0 %)	14 (46.7 %)	35 (58.3 %)	0.067

Table 3 Relative chance of success of treatment with Epley maneuver compared with Gans after controlling the confounding factor

	Standard error	*p* value	Odds ratio	95 % CI for EXP(B)	
				Lower	Upper
Subjective response after 24 h	0.654	0.025	4.32	1.2	15.6
Objective response after 24 h	0.651	0.014	4.97	1.38	17.8
Subjective response after 1 week	0.541	0.070	2.66	0.92	7.69
Objective response after 1 week	0.541	0.070	2.66	0.92	7.69

of Epley-repositioning maneuver compared with Gans in 1 day, but this response rate was equal after 1 week of follow-up (~70 %). This indicated that the recurrence of symptoms was more frequent after Epley maneuver, and means that the irreversibility of the therapeutic effects of Gans maneuver was more than Epley.

The follow-up and assessment times of study are acceptable compared with the previous studies [27, 28] although some others followed the subjects for longer duration [29]. Because of the chronicity of this syndrome and its annoying nature, searching for a treatment with more permanent efficacy is desired, so comparing the long-term results of different treatment modalities is obviously of importance. Richard assessed 81 patients for 6 months and obtained improvement rates of 89 and 92 % and 1 month and 6 months after Epley maneuver, respectively. The higher rate of recovery after 6 months probably can be explained by the habituation of peripheral vestibular system. This mechanism can also describe the difference of his results with ours that was achieved after a shorter period of time [29].

In Robert et al. study, the results of 1 week after trial with Gans maneuver in combination with ordered post-maneuver restrictions indicated 80.2 % of recovery rate by one course of intervention and 95.6 % by two courses and 99 % after three times of intervention [24]. In Gans study, also 80 and 96 % of patients exhibited improvement after one and two trials of Epley maneuver, respectively [20]. The higher rate of improvement achieved by Robert's study can be attributed to repetition of the maneuver (such as in Gans study) and also post-maneuver restriction. Of course, some studies did not confirm the additional benefit of such restrictions [11, 30–32], and so, in our study, we did not aim for searching the effects of post-maneuver restrictions.

Von Brevern et al. accounted the response to Epley maneuver after 1 day and 1 month as 80 and 85 %, with significant difference. The 1 day response was in agreement with our results. They also determined that the complications of this maneuver included nausea and vomiting which were transient and with low frequency [28].

A noticeable result of the present study was comparing the complications of two maneuvers, including the increasing of the frequency and severity of vertigo and onset of nausea and vomiting and also low back pain which were not significantly different between two groups of treatments. However, higher rate of cervical pain was observed by Epley maneuver. This conclusion insists on using Gans maneuver in special conditions in which the protection of neck structure is essential, considering the similar response of both maneuvers especially in long term.

The mean age of our patients was 46.75 ± 10.45 years, such as Richard and Von Brevern and also Mujeeb studies, which all indicate the age-related nature of disorder [28, 29, 33]. In addition, in the above-mentioned studies, such as ours, the treatment response was not related to age [28, 29], so choosing the maneuver is not depended to patient's age. However, considering some complications of the maneuvers which may have more impacts on older age subjects, attention to their age seems to be essential in selection of the therapeutic maneuver.

Such as reported by Roberts, Von Brevern and Gans [20, 24, 28], in the present study, the women was involved two to three times as much as men, but the response to treatment was not related to the patient's gender [20, 28].

The side of involvement did not affect response rate by both maneuvers; similar to the findings of Richard and Helminski studies [29, 34]; except for the only case with bilateral involvement that responded to Gans maneuver only in the first 24 h. Because of low frequency of bilateral involvement which was as the same as Richard study, this result cannot be supported [29].

We also assessed the association between the duration from the first attack of BPPV and response to treatment, which revealed no association, except who responded subjectively in the first day had shorter duration of BPPV acquisition ($p = 0.005$).

It is noteworthy that the first attack of BPPV responded significantly better to Epley maneuver compared with Gans maneuver in two assessment time points, whereas the recovery of recurred attack did not differed by two maneuvers ($p > 0.05$). It may affect the maneuver selection based on the prior history of BPPV.

Gans et al. defined the recurrence as the repetition of the symptoms after 1 month, and reported the recurrence rate after Epley maneuver by 7 % in one study [20]. The objective recurrence rate after Epley and Gans maneuvers has been estimated as 16 and 10 %, respectively, after 1 week in the present study, but if we followed the patients for longer duration and considering Gans definition for recurrence, the same results might be achieved specially in comparison with Gans maneuver. In the other studies done by Herdman, the recurrence rate after Epley has been reported as 10–30 % [18] and after Gans maneuver as 5 % [24] which also represent the lower recurrence rate of Gans maneuver.

We aimed to the long-term subsidence of symptoms and nystagmus (which was similar in two maneuvers) and lower complication rate (which was achieved by Gans maneuver) as the measures of selecting a treatment option in BPPV cases.

Badawy et al., who made comparison between the effect of a hybrid treatment, the Gans-repositioning maneuver (GRM) either with or without post-maneuver restrictions with Epley maneuver on the treatment of posterior canal BPPV (PC-BPPV), demonstrated that the GRM was

effective in treating PC-BPPV with no benefits to post-maneuver restrictions and its effect was equal with Epley maneuver. In this study, only two patients had recurrence, and one patient had horizontal BPPV at 1 month follow-up. This survey, such as the previously mentioned article, followed the patients for longer period with less recurrence rate than ours, but their sample size was very smaller in each group and no complication assessment was done, whereas the rate and type of the complications were considered in our investigation as the measure of priority of selected maneuver [35].

Conclusion

The higher subjective and objective success rate of Epley-repositioning maneuver has been achieved compared with Gans in 1 day, but after 1 week of follow-up, the results obtained in two maneuvers were equal, which indicates that the irreversibility of the Gans maneuver was more than Epley. Given the similarity of the groups on several factors (age, gender, involved ear, duration, and prior history of BPPV), along with the fact of similar response to both maneuver, the repositioning maneuver should be chosen considering the complications of maneuver. The only complication that occurred with a higher rate by Epley maneuver was cervical pain that enforce on using Gans maneuver in special conditions in which the protection of neck structure was essential. Therefore, it seems that in special conditions, such as old age and cervical and sometimes lumbar problems, Gans maneuver would clearly be more appropriate for its technical performance and having fewer complications.

We suggest a comparative study with a longer time of follow-up by considering the other potentially confounding variables and attempting to control them. In addition, the determination of the recurrence rate of repositioning maneuvers is a useful point.

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Compliance with ethical standards

Conflict of interest No conflicts of interest.

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