Importance of accurate diagnosis in benign paroxysmal positional vertigo (BPPV) therapy

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ABSTRACT

Aim To determine the importance of accurate topological diagnostics of the otolith and the differentiation of certain clinical forms of benign paroxysmal positional vertigo (BPPV).

Methods A prospective study was conducted at the County General Hospital Vukovar in the period from January 2011 till January 2012. A total of 81 patients with BPPV, 59 females (72.84%) and 22 (27.16%) males (p <0.001), mean age 60.1 (± 12.1) were examined. The diagnosis was confirmed and documented by videonystagmography (VNG). The disability due to disease and risk of falling were monitored by filling in the Dizziness Handicap Inventory (DHI) and Activities-specific Balance Confidence Scale (ABC) questionnaires at the beginning and at the end of the repositioning treatment.

Results In 79 (97.3%) patients posterior semicircular canal was affected, and in a small number of patients, two (2.47%) the lateral one. After the repositioning procedures were performed, there was a significant reduction or complete elimination of symptoms in the majority of subjects, 76 (93.82%). The median total DHI sum amounted to 50.5 (± 22.2) at the beginning and 20.4 (± 18.5) at the end of the study (p <0.00). Similarly, the results of ABC questionnaires at the beginning of the study demonstrated a result of 59.2% (± 22.4%), and at the end of the treatment the average result of examinees was significantly higher, 84.9% (± 15.2%) (p<0.00).

Conclusion Although a subjectively positive Dix-Hallpike or a “supine roll” test is sufficient for the diagnosis of BPPV, it is necessary perform the VNG as well in order to precisely determine the exact localization of the otolith, so that an appropriate repositioning procedure can be applied.

Key words: diagnosis, videonystagmography, canalolithiasis, cupulolithiasis, canalith repositioning procedures
INTRODUCTION

Benign paroxysmal positional vertigo (BPPV) still frequently remains undetected, although it represents about 20-40% of the total number of peripheral vertigo cases in general population (in the elderly population even up to 50%) (1,2), and a subjectively positive Dix-Hallpike or a “supine roll” test is sufficient for the diagnosis. The most common form of BPPV is the one in which the posterior or semicircular canal is affected (in approximately 70-90% of cases), while the remainder relate to the lateral semicircular canal. The anterior and mixed type account for only a very small percentage of cases (3,4). Although extremely rare, the otolith localization in the anterior semicircular canal is significant because the form of nystagmus can appear as lesions on the central nervous system (5,6). According to Lopez-Escámez et al. (7), a simultaneous involvement of multiple semicircular canals is not a rare case, and the values in these authors range up to 20%. Tomaz et al. (8) report that multiple canals are rarely affected, and if so, they are usually the canals on the same side. In such cases there is a far more frequent involvement of the posterior and lateral canal combination, than the anterior and posterior canal or the anterior and lateral one.

In his research Yagi et al. (9) demonstrated by a 3D analysis of videonistagmography (VNG) records, that most (2/3) localizations of BPPV obtained by the analysis of VNG do not coincide with the direction of nystagmus. In addition, the introduction of Video Head Impulse test (10) also shows that the plain observation of a possible occurrence of saccadic nystagmus is not sufficient and that it cannot notice all the precise eye movements. Beside the typical clinical canalolithiasis picture of the posterior semicircular canal, the finding of cupulolithiasis is far more common than initially thought (11,12). In some patients, quite different pictures of BPPV may appear, such as nonspecific dizziness, blurriness, unsteadiness in walking (13,14), etc.

The objective of this prospective clinical study was to determine the importance of accurate topological diagnostics of the otolith and the differentiation of certain clinical BPPV forms in order to postulate an appropriate repositioning procedure. It should have provided a rapid and complete recovery and reduced risk of patients’ falling and suffering injuries.

PATIENTS AND METHODS

Study organization

The study was devised as an original scientific research based on prospective clinical trials (15-17). All data were collected during the clinical examination and patient treatment. The sources of the data obtained were general otoneurologic history, an otoneurologic review, particularly the Dix-Hallpike test and videonystagmography, as well as questionnaires Dizziness Handicap Inventory (DHI) or the classification table of dizziness and Activities-specific Balance Confidence Scale (ABC), a scale of balance confidence with respect to the activities. During the study, the data were systematically entered into a database created particularly for this study and saved by regular backups.

Patients

Potential examinees were all the patients who reported to the Ear, Nose and Throat (ENT) Department of the County General Hospital Vukovar Croatia between January 2012 and January 2013 having balance problems of either central or peripheral origin. Among them, 81 patients with BPPV were selected by a positive Dix-Hallpike test. The diagnosis was then confirmed and documented by VOG. The used device is a computerized VO425 system (Interacoustics, Denmark). All the patients who agreed to the study and signed an informed patient’s consent, a document in which they are made fully familiar with the type and method of research, as well as potential risks. The study was approved by the Ethics Committee of Vukovar County General Hospital.

The overall tests conducted to confirm the diagnosis of BPPV in all the examinees were the following: history, which includes some general demographic characteristics (gender, age, occupation, level of education, social status) otoscopic examination, otoneurologic review, with a mandatory Dix-Hallpike and “supine roll” test, VNG (analysis of spontaneous, visual and positional nystagmus, analysis of Fitzgerald-Hallpike bithermal caloric test), filling in the DHI and the ABC forms.

In some cases, if there was a reasonable suspicion of some other cause of dizziness, additional diagnostic tests were made, such as the following:
tone audiometry, tympanometry, radiological examinations (brain CT and MRI, cervical spine X-ray), carotid and vertebral arteries color Doppler (CDFI), vascular vertebrobasilar-confluence transcranial Doppler (TCD).

The patients were subjected to appropriate repositioning procedures depending on whether it was a BPPV in the posterior, lateral or anterior semicircular canals, and whether it was a case of canalo or cupulolithiasis.

Methods

The overall duration of the study was eight weeks, with the first examination completed upon the patient’s reporting to our specialist clinic. It included the previously mentioned diagnostic tests and filling out two questionnaires individually in a peaceful and quiet room. The first of these was a specific, non-commercial Dizziness Handicap Inventory (DHI) questionnaire designed to quantify the difficulty and disability in everyday activities that patients experience due to vertigo (15). It consists of 25 questions, (15) seven of which are related to physical, and nine on both emotional and functional health. The responses were rated in the following way: the answer “no” – zero (0) points, the answer “sometimes” – two (2) points and the answer “always” – four (4) points. Accordingly, the maximum sum was 100, and the minimum 0 points. Within the sum, the maximum number of points for physical health was 28, and for the state of emotional and functional health 36 points. The higher sum indicates a greater disability of patients, and the study assumed18 and higher sums as clinically significant (16-18). Awarded 60 points in DHI test indicates a high probability of falling within the next six months.

The second questionnaire was the ABC scale. This questionnaire is compatible with the DHI scale, and they are often used together. It is a very useful test in assessing the difficulties that the patients feel due to their dizziness, risk of falling, the quality of their quotidian life, as well as their general health status (19).

A reposition of the posterior semicircular canal otolith was performed by the Epley Canalith Repositioning Procedure, while lateral semicircular canal otolith reposition was performed by Lempert procedure. Repositioning procedure was performed twice in one session and a follow-up examination was administered a week subsequent to the treatment initialization. It was performed by the Dix-Hallpike with the repeated DHI and ABC questionnaires in case of weakening the clinical symptoms of BPPV and feature of nystagmus in the Dix-Hallpike. If symptoms had not disappeared completely, the Epley procedure was repeated twice in one session and a new follow-up examination was administered in a week after the cure or remission due to a repositioning treatment. Then, using the same instruments, the patients’ health status and quality of life were determined and a statistical analysis of the results was made in correlation with the initial status.

Statistics

The figures following a normal distribution were described by an arithmetic average value and standard deviation. With numerical data that do not follow the normal distribution for the average assessment the non-parametric measures of central value (median) were used as the 25th and the 75th centile scattering assessment. The regularity of observed numeric data distribution was tested by the Kolmogorov-Smirnov test. Categorical variables were described in absolute and relative frequencies. To explore the differences between the two dependent samples, Friedman and Wilcoxon test were used for data not normally distributed; the T-test for paired samples, and ANOVA for repeated measurements for the data following normal distribution. To assess the materiality of results, the level of essentiality p=0.05 was chosen.

Ethical principles

During this clinical research, the ethical principles were respected in accordance with the well-known and established basic principles of ethics and human rights applicable in the field of biomedical science.

RESULTS

The study encompassed 81 patients whereof there were significantly more females, 59 (72.84%) and 22 (27.16%) males (p <0.001). The average age was 60.1 (± 12.1): 59.4 (± 12.2) for women and 61.9 (± 11.7) for men (Table 1).

In 46 (56.79%) patients, the problem was canalo or cupulolithiasis and in 35 (43.21%) cupulolithiasis, where the posterior semicircular canal or its ampule
was primarily affected, in 79 (97.53%), while the lateral semicircular canal was affected in two (2.47%) patients (Table 2, Figure 1).

The number of repositioning procedures ranged from 2 to 6, the median being two treatments (interquartile range 2-3), after which there was a significant reduction or a complete elimination of symptoms in all patients.

In all patients, significantly higher values were shown during initial examination in all groups of questions applying the DHI questionnaire (physical, mental, and emotional health) in relation to the check-up (p <0.001) (Figure 2). The mean value (standard deviation) for physical health at the first examination was 20 (± 10.4), while the final one was 8.2 (± 7.9), with p <0.001. The result for mental health at the start was 18.5 (± 6.8), while in the end it was 7.5 (± 6.8) (p<0.001). The value for emotional health at the first examination was at 12.2 (± 9.2), and at the final check-up at 4.7 (± 5.7) (p<0.001). The mean value (standard deviation) of the total DHI sum was 50.5 (± 22.2) at baseline and 20.4 (± 18.5) at the end of the study (p <0.001) by Wilcoxon test. During the initial exa-

Table 1. Median age of patients according to gender

<table>
<thead>
<tr>
<th>Gender</th>
<th>No (%) of patients</th>
<th>Average age (SD) (Min - Max)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Males</td>
<td>22 (27.2)</td>
<td>61.9 (11.7) (39 – 79)</td>
<td>0.483</td>
</tr>
<tr>
<td>Females</td>
<td>59 (72.8)</td>
<td>59.4 (12.3) (24 – 81)</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>81</td>
<td>60.1 (12.1) (24 – 81)</td>
<td></td>
</tr>
</tbody>
</table>

SD, Standard deviation;

Table 2. Affected labyrinth and orientation of nystagmus in the Dix-Hallpike test

<table>
<thead>
<tr>
<th>Dix-Hallpike</th>
<th>No (%) of patients</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Right Geo</td>
<td>18 (39.1)</td>
<td>0.122</td>
</tr>
<tr>
<td>Right Apogeo</td>
<td>20 (57.1)</td>
<td></td>
</tr>
<tr>
<td>Right Total</td>
<td>38 (46.9)</td>
<td></td>
</tr>
<tr>
<td>Left Geo</td>
<td>28 (60.9)</td>
<td></td>
</tr>
<tr>
<td>Left Apogeo</td>
<td>15 (42.9)</td>
<td></td>
</tr>
<tr>
<td>Left Total</td>
<td>43 (53.1)</td>
<td></td>
</tr>
<tr>
<td>Total Geo</td>
<td>46 (100%)</td>
<td></td>
</tr>
<tr>
<td>Total Apogeo</td>
<td>35 (100%)</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>81 (100%)</td>
<td></td>
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</tbody>
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Geo, geotropic nystagmus (directed towards the ground, i.e., towards the lower lying ear); Apogeo, apogeotropic nystagmus (directed opposite of the ground, i.e., toward the upper ear)

Figure 1. Affection of ampoules side/posterior semicircular canal and presence of canalolithiasis/cupulolithiasis among the patients

DISCUSSION

The BPPV often remains unrecognized, although it is the most common cause of all cases of dizziness and even though a subjectively positive Dix-Hallpike or “supine roll” test result should be sufficient for the accurate diagnosis of this disease, according to the Guidelines of the United States Academy of Otolaryngology and Head and Neck Surgery in 2008 (19). Our observations showed that it is also very important to perform the VNG tests in order to confirm and set precise diagnosis with respect to the affected ear, the affected canal, and its part, because it is sometimes very difficult to accurately exclusively determine all the parameters on the basis of conducted posi-
tional tests. Once the diagnosis is set, it is important to assess and monitor the patients’ physical, emotional, and mental status and determine their risk of falling (20-22).

The average age of patients in this study of 60.1 (± 12.1) corresponds to other studies. Our results also show that a BPPV disease mainly affects elderly persons, largely due to various degenerative changes associated with the aging process (23, 24).

When it comes to the patients’ gender, there was a significantly higher prevalence of females (72.8%) compared to males (27.2%), so that the ratio was about 2/3 : 1/3. An equal representation of both sexes is described only in a BPPV that occurs after injury (25). There was no difference in age according to gender (26,27).

In the majority of cases in this study (93.82%), two repositions in one session were enough for a significant recovery of the patient, which is almost equal to healing, allowing the patients to return to their daily life activities (28-30).

According to the sides affected by the disease, an equal involvement of both ears was shown in this study. In the medical literature available, most authors found a significantly higher incidence of involvement of the right labyrinth in relation to the left. Von Brevern et al. speculate that this finding is a result of sleeping habits on the right for most people, and Damman et al. only confirm their claims (31,32).

Considering the involvement of individual semicircular canal, the prevalence of otolith settled in the lateral canal (2.47%) corresponds to the data from other studies (33,34). In contrast, with regard to nystagmus direction, the prevalence of ageotropic direction (43.21%) in this study was higher than it was expected. This could be explained by a relatively small sample and a precise VNG diagnosis. Over the last ten years, some authors also report a significantly higher prevalence of canalal and cupulolithiasis of lateral semicircular canal, explicable by their accurate diagnosis (35-37).

The Croatian version of the simple DHI questionnaire accepted world-wide, translated and adapted to local population was used as a tool to examine the impact of BPPV on patients’ disability. The questionnaire is specific for testing the impact of various forms of dizziness on patients’ handicap and their everyday life, seen from their perspective. The study subjects filled this questionnaire during the first examination and the final check-up. The results of DHI testing on individual issues showed a statistically significant difference in answers to certain questions among respondents. The similar results were found for the results in relation to each group of questions as well. The highest sum was observed upon both the first examination and the final check-up in the group of questions related to physical health. Upon the final check-up, it is evident that there was a statistically significant improvement in answers to all three sets of questions, with still the largest average scoring total for the group of questions related to physical health. Nevertheless, this result is within normal physiological limits, while the results of the other two groups of questions related to mental and emotional health are fully within the normal framework, set out for local population. The mean values of total DHI score and all subscales, before and after repositioning treatment, corresponding to the results of other authors, as well as our previously published results (38-41). A relatively high initial scoring sum may be noted, which over time improves and becomes smaller, so that most answers in the questionnaire were negative.

The second questionnaire filled was the ABC scale of balance confidence. This test is very reliable in assessing the difficulties that a respondent faces due to dizziness, danger of falling, general health and quality of daily life. It showed a good correlation with the results of the DHI test (29). The results obtained by completing the questionnaire at the beginning of treatment showed the score of 59.2% (± 22.4%), and thus pointed to a significant risk of falling and possible injury, before repositioning procedures were applied. In contrast, at the end of the treatment, which consisted of at least two and a maximum of six repeated repositioning procedures by Epley, the average score of respondents was significantly higher at 84.9% (± 15.2, far from the score which represents the risk of falling. In all patients involved in the study, subsequent to the diagnosis of BPPV by the Dix-Hallpike and “supine roll” test and proven by the VNG findings, an appropriate procedure of otolith reposition was performed (Epley, Lempert). In the majority of cases it was sufficient for a significant recovery of the patient. The DHI and ABC questionnaires were used in monitoring the status of patients’ disability and their quality of life related to health, especially in monitoring their progress during the treatment. Subsequent to a result analysis, one may conclude the following: the average scoring sum of both administered qu-
estionnaires at the beginning and the end of the treatment showed a statistically significant improvement, indicating the improvement of life quality related to physical, emotional and mental health, as well as a reduction of disability in performing usual, everyday activities. The risk of falling in patients is also significantly reduced: while the initial risk of falling and subsequent injury was very large, at the end of the treatment there was no real danger of falling that would have been caused by vertigo.

We must point out the significant role of VNG treatment in setting the precise diagnosis of otolith localization and clinical forms of BPPV, which allowed us to conduct the most appropriate reposition process and thereby achieve satisfactory results in treatment.

**FUNDING**

No specific funding was received for this study.

**TRANSPARENCY DECLARATIONS**

Competing interests: none to declare.


**REFERENCES**

SAŽETAK
Cilj Utvrditi važnost precizne topografske dijagnoze benigne paroksizmalne pozicijske vrtoglavice (BPPV) kako bi se moglo primijeniti najprimjereniji oblik njegova liječenja.

Metode Prospektivna studija provedena je u Općoj bolnici Vukovar, od siječnja 2011. do siječnja 2012. godine. Ispitan je 81 pacijent obolio od BPPV-a, odnosno 59 žena (72,84%) i 22 muškarca (27,16%) (p <0,001), prosječne životne dobi 60,1 (± 12,1) godina. Dijagnoza je potvrđena i dokumentirana videonistagmografiom (VNG). One stopoblenost boleću i rizik od padanja praćeni su popunjavanjem dvaju upitnika, tablice klasifikacije vrtoglavica (DHI) i ljestvice sigurnosti ravnoteže s obzirom na aktivnosti (ABC), prije i nakon repozicijskog liječenja.

Rezultati U 79 (97,3%) pacijenata bio je zahvaćen stražnji polukružni kanalić, dok je bočni bio zahvaćen u 2 (2,47%) slučaja. Nakon primijenjenog repozicijskog liječenja, došlo je do značajnog poboljšanja, a čak i potpunog povlačenja simptoma kod 76 (93,82%) bolesnika. Prosječan skor ABC-a na početku istraživanja pokazivali su vrijednost od 59,2% (± 22,4%), dok je prosječan rezultat na koncu studije bio značajno viši i iznosio 84,9% (± 15,2%).

Zaključak Iako je za postavljanje dijagnoze BPPV-a dovoljna pozitivna Dix-Hallpikeova ili "supine roll" proba, poželjno je učiniti i VNG pretragu, poglavito kod sumnje na zahvaćenost bočnog kanalića, s ciljem precizne dijagnoze bolesti i najprimjerenijeg liječenja, ali i rasvjetljavanja čestih nedoumica da li se BPPV pojavljuje kao samostalna bolest ili u sklopu nekog drugog vertigoznog entiteta.

Ključne riječi: dijagnoza, videonistagmografija, kanalolitijaza, kupulolitijaza, postupak repozicije otolita

Značaj precizne dijagnoze u liječenju benignog paroksizmalnog pozicijskog vertiga (BPPV)

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¹Opća županijska bolnica Vukovar, Vukovar; ²Opća bolnica “Josip Benčević”, Slavonski Brod; ³Klinika za neurologiju Kliničko-bolničkog centra Osijek; Hrvatska

CILJ Utvrditi važnost precizne topografske dijagnoze benigne paroksizmalne pozicijske vrtoglavice (BPPV) kako bi se moglo primijeniti najprimjereniji oblik njegova liječenja.

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KLJUČNE RIJEČI: dijagnoza, videonistagmografija, kanalolitijaza, kupulolitijaza, postupak repozicije otolita