Our Results of VHIT on BPPV

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Abstract

Objective: We reported the differentiation of vestibulo-ocular reflex (VOR) gains and saccades in a video head impulse test (VHIT) of the semicircular canals of 49 patients with vertigo. They were diagnosed with benign paroxysmal positional vertigo (BPPV).

Material and Methods: In total, we evaluated 49 patients who were referred to our clinic due to vertigo within the first 10 days based on history between June 2016 and February 2017; of these, 30 patients were diagnosed with vertical canal BPPV according to the Dix–Hallpike test and 19 with lateral canal BPPV using the Roll test. Patients were evaluated according to age, sex, presence of saccades, and VOR gains of all the semicircular canals.

Results: Overall, 17 patients were males and 32 were females. The age ranged between 23 and 73 years (mean age, 50 years). The VOR gains were normal in 17 (34%) patients. Based on the VHIT findings, 20 patients (40%) had low VOR gains in the vertical canal, 12 (24%) in the lateral canal. Saccades was determined in 20 patients with canal pathology.

Conclusion: History and provocation maneuver are gold standards in the diagnosis of BPPV. VHIT was affected by the applied power of the clinician and the angular position of the head. Consequently, this test can be used as supporting diagnostic test.

Keywords: Benign paroxysmal positional vertigo, video head impulse test, vestibulo-ocular reflex gain

INTRODUCTION

The video head impulse test (VHIT-EyeSeeCam from Interacoustics a/s, Middelfart, Denmark) is a new diagnostic tool, which is used to assess the function of the three semicircular canals as well as the superior and inferior vestibular nerve functions. It is based on the recording of the vestibulo-ocular reflex (VOR). During the head movement, a movement occurs in the endolymph, and this is transmitted to the vestibular nerve and then to the vestibular nucleus. The signal at the pons level is transmitted to the oculomotor nucleus; the lateral rectus of the opposite side and the medial rectus of the same side are stimulated, resulting in horizontal eye movement that reaches the opposite ear. If there is a problem with VOR, the saccade, known as compensatory eye movements, will emerge. Both the saccades and VOR gains are recorded in the form of diagrams in VHIT (EyeSeeCam from Interacoustics a/s, Middelfart, Denmark) (1).

The use of VHIT (EyeSeeCam from Interacoustics a/s, Middelfart, Denmark) in BPPVs still new, and there are no standard values related to the VOR gains that belong to the semicircular canals. Here, we present the changes in the VOR gain values and saccade incidence rates of all semicircular canals in patients with BPPV at an acute stage.

MATERIAL AND METHODS

Forty-nine patients who were referred to our outpatient clinic due to vertigo within the first 10 days between June 2016 and February 2017 and who were diagnosed with BPPV based on their history, Dix-Hallpike test, and the Roll test were included in the study. The study was conducted in accordance with the ethical standards of the Helsinki Declaration. Written informed consent was obtained from patients who participated in this study.

The VOR gains of each patient were recorded in all semicircular canals using an EyeSeeCam VHIT device (EyeSeeCam from Interacoustics a/s, Middelfart, Denmark). When the test is performed, the patient is seated 1.5 m away from the target and is requested to wear glasses. The individual applying the test stands behind the patient and supports the patient's jaw and head with both hands. Once the patient fixes his/her eyes to the target, the head is rotated parallel to the X and Y axes five times to calibrate the device. These movements should not exceed 100°/s. Then, the head

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is rotated 20°–30° in the direction of the tested canal, and the speed of the head and eye movements are recorded to calculate the VOR gains. The standard VOR values for semicircular canals were prerecorded by the device in VHIT (EyeSeeCam from Interacoustics a/s, Middelfart, Denmark) performed in 20 normal individuals. The lower value of the normal standard VOR was accepted as 0.9 for the lateral canal and 0.7 for the vertical canal.

RESULTS

Of the patients, 17 were males and 32 were females. The age range was between 23 and 73 years, and the mean age was calculated as 50 years. According to the VHIT (EyeSeeCam from Interacoustics a/s, Middelfart, Denmark) results, the VOR gains were found to be normal in 17 patients (34%). The VOR gains in the vertical canal were lower in 20 of the 30 patients who were diagnosed with vertical canal BPPV according to the Dix-Hallpike test; the lateral canal VOR gains were found to be lower in 12 of the 19 patients who were diagnosed with lateral canal BPPV according to the Roll test. While the VOR gains in the vertical canal were <0.7 in 20 patients (40%), the VOR gains in the lateral canal were <0.9 in 12 patients (24%). While the saccade was not observed in any of the 17 patients who had normal VOR gains (VHIT negative), it was observed in 20 (62.5%) of the 32 patients who had low VOR gains (VHIT positive).

In the VHIT (EyeSeeCam from Interacoustics a/s, Middelfart, Denmark) results of the 20 patients who were diagnosed with BPPV in the vertical canal, there were pathologies in the left posterior canal in 15 patients, in the right posterior canal in three patients, in the right anterior canal in one patient, and in the left anterior canal in one patient. The mean pathological VOR value for the vertical canals was 0.5. Of the 12 patients who were diagnosed with BPPV in the lateral canal, the left lateral canal was affected in 10 and the right lateral canal in two. The pathological VOR value was found to be 0.7 for the lateral canals.

DISCUSSION

Benign paroxysmal positional vertigo is the most common peripheral vestibular disorder characterized by episodic vertigo attacks, that gets active with head movements. It was first described by Barany in 1921 (2). BPPV is caused by canalolithiasis or cupulolithiasis wherein all three canals are affected; however, it is extremely rare in the superior (anterior) canal. It is often seen in one canal and occurs in the posterior canal most commonly, but it can involve both posterior and lateral canals in the same ear. The Dix–Hallpike and Roll tests are used for diagnosis (3). We performed VHIT (EyeSeeCam from Interacoustics a/s, Middelfart, Denmark) in patients diagnosed with BPPV using Dix Hallpike and Roll tests. We found pathology in the vertical canal in 20 patients (40%) and in the lateral canal in 12 patients (24%).

While VHIT (EyeSeeCam from Interacoustics a/s, Middelfart, Denmark) quantitatively gives us the defects in VOR, it records overt and covert saccades. While the overt saccade is the catching motion in the eyes, which emerges after head rotation, the covert saccade is the catching motion that we cannot detect with our eyes at the time of head rotation (4). While VHIT (EyeSeeCam from Interacoustics a/s, Middelfart, Denmark) was found to be positive at a rate of 63% in acute cases (the onset of the symptoms within the first 5 days), it was found to be 33% in nonacute cases (those with symptom duration over 5 days); it was found to be positive at a rate of 41% on average in all cases (5). In our study on 49 acute cases, VHIT (EyeSeeCam from Interacoustics a/s, Middelfart, Denmark) was positive in 32 patients. The sensitivity was 65%.

The video head impulse test allows the identification of the damaged area in the vestibular organ, and it also helps to assess the efficacy of the medical treatment provided and the rehabilitation maneuvers performed (6).

The VOR gains in VHIT (EyeSeeCam from Interacoustics a/s, Middelfart, Denmark) are affected according to the person who conducts the procedure, his/her hand position, and by many factors, such as the speed of head rotation, the tightness of the eye patch, and the distance from the wall. Therefore, instead of the VOR gains, the presence or absence of the saccade is accepted as a determinant by some researchers. Therefore, Mabrey et al. obtained pathological horizontal canal vestibuloocular reflex (hVOR) gains in normal patients at the rates of 7.5%-8.9% (7). Consequently, it is suggested to focus on the presence of the saccades first and then on the gains for evaluating the VHIT (EyeSeeCam from Interacoustics a/s, Middelfart, Denmark) results (1). While the saccade was not observed in any of the 17 patients with negative VHIT (EyeSeeCam from Interacoustics a/s, Middelfart, Denmark) results, it was observed in 20 (62.5%) of the 32 patients with positive VHIT (EyeSeeCam from Interacoustics a/s, Middelfart, Denmark) results.

Blöwdow et al. (8) defined the VOR gain for the normal horizontal canal as 0.96 and the lower value as 0.79. In another study, the normal VOR gain value for the lateral canal was found to be a minimum of 0.87 and a maximum of 1.14 (9). In our study, the normal standard VOR value for the lateral canal was 0.9 and for the vertical canal was 0.8. The values smaller than this were accepted as pathological. While the mean pathological VOR value was 0.5 for the vertical canals, it was 0.7 for the lateral canals.

The video head impulse test presents us with the level of pathology of the vestibular nerve itself or its branches; for example, in the anterior and lateral canal damage in vestibular neuritis, it can demonstrate superior vestibular nerve involvement and inferior vestibular nerve damage, indicating posterior canal damage, or it can demonstrate the situations wherein both are involved. VHIT is also used for the distinction of central vestibular diseases, the investigation of superior canal dehiscence, and the control of posterior canal occlusion in resistant BPPV (10, 11).

CONCLUSION

The history and then the provocation maneuvers are the most important elements in the diagnosis of BPPV. VHIT can be used to obtain quantitative data; however, as the VOR gains can change, we believe in considering the saccades that are more objective. We think that the use of VHIT will be increased by more studies being conducted on VHIT with regard to BPPV.

Ethics Committee Approval: Authors declared that the research was conducted according to the principles of the World Medical Association Declaration of Helsinki "Ethical Principles for Medical Research Involving Human Subjects", (amended in October 2013).

Informed Consent: Written informed consent was obtained from patients who participated in this study.

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