The visual-ocular and vestibulo-ocular reflexes in vestibular migraine

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ABSTRACT:
Vestibular migraine is a disease from the border of neurology and otoneurology. The diagnosis depends on patient history. There are no valuable laboratory or imaging tests, therefore the examination of visual-ocular and vestibulo-ocular reflexes is very useful in this group of patients. The material was collected from patients diagnosed due to dizziness at the Department of Otolaryngology and Oncology with the Subdepartment of Audiology and Phoniatrics, CM UMK in Bydgoszcz in 2019–2021. We considered patients with vestibular migraine and analyzed videonystagmographic tests in this study. The most common VNG abnormalities in patients suffering from vestibular migraine were an increased labyrinthine response, increased time constant of the rotational response and abnormal optokinetic response. There was not a single case of canal paresis in the group of patients with vestibular migraine.

KEYWORDS:
nystagmus, vestibular migraine, vestibulo-ocular reflex, videonystagmography

ABBREVIATIONS
CGRP – calcitonin gene-related peptide
CM UMK – Collegium Medicum of Nicolaus Copernicus University
CNS – central nervous system
cVEMP – cervical vestibular-evoked myogenic potentials
ENT – ear, nose, throat
SOT – sensory organization test
VEMP – vestibular-evoked myogenic potentials
VNG – videonystagmography

INTRODUCTION
Vestibular migraine is a disease from the border of neurology and otoneurology. Despite a frequent occurrence, it is estimated to be diagnosed too rarely [1]. The spectrum of symptoms includes migraine headaches, with or without aura, with additional vestibular symptoms, but usually not simultaneous.

Dizziness is more bothersome than pain and becomes the main symptom of the interviewed patients. Low recognition of vestibular migraine arises from the interdisciplinarity of the disease and lack of pathognomonic laboratory tests or imaging studies. The International Headache Society and the Barany Society has developed criteria which are based on medical history [2]. Therefore, a study of vestibulo-ocular reflexes using videonystagmography is a useful test that allows to identify the correct diagnosis.

AIM
The aim of the study was to assess the usefulness of visual- and vestibulo-ocular reflexes in vestibular migraine.

MATERIAL AND METHODS
The material was collected from patients diagnosed due to dizziness at the Department of Otolaryngology and Oncology with the Subdepartment of Audiology and Phoniatrics, CM UMK in Bydgoszcz in 2019–2021. The medical histories and research results of otoneurological and audiological patients diagnosed with vestibular migraine were analyzed (33 patients: 30 women, 3 men; age range 23–64; average age 45.8 years). All patients were diagnosed according to the same protocol. The considered elements of medical history were: age, gender, time of symptom onset, symptoms (headache, nausea, photophobia, visual impairment, hyperacusis, tinnitus, sensation of aural fullness, hyperosmia, dizziness and vertigo), duration of symptoms.
**Module:** Caloric Test

**Stimulation:** Water – Temperature: 30°C/44°C - **Irrigation time:** 20s

**Date:** 10/12/2019

**Fig. 1.** Vestibular hypersensitivity.

**Module:** Spontaneous Nystagmus

**Examination:** Right Side

**Date:** 29/10/2020

**Fig. 2.** Positional nystagmus.
The second most frequent symptom was headache, described as hemicranial or pulsatile. It was reported in 33 patients (100%). The duration of headaches ranged from a few days to several minutes, most often several hours in repeated episodes 1–2 times a month.

On the other hand, a large percentage of patients reported dizziness lasting several seconds all the time (23 – 69.69%).

The spectrum of symptoms that preceded the seizure of dizziness and headache were (the most common): photophobia (24–72.73%), hyperacusis (12–36.36%), tinnitus during the seizure (4–12.12%), a sensation of aural fullness (2–6.06%), hyperosmia (2–6.06%), numbness in the face or limbs (3 – 9.09%). One person reported a loss of consciousness during a seizure (0.03%).

Audiometric evaluation in the group of patients with Vestibular Migraine revealed no abnormalities in tonal audiometry, otoacoustic emission, and auditory brainstem responses. The sensation of aural fullness and hyperacousis reported by patients failed to confirm any damage to the ear canal in audiological testing.

The results of Cervical Vestibular Evoked Myogenic Potential Testing (cVEMP) were within the normal range in ipsi- and contralateral tests; deviations were noted only in 2 patients (6.06%).

Videonystagmography showed deviations typical of vestibular migraine.

RESULTS

There were 33 cases of Vestibular Migraine among patients diagnosed at the Department of Otolaryngology and Oncology with the Subdepartment of Audiology and Phoniatrics, CM UMK in Bydgoszcz in 2019–2021. These cases were almost exclusively women (30 patients – 90.90%).

Age range: 23–64, average age 45.8 years.

The symptoms appeared between the ages of 19 and 47, on average at the age of 39, and the duration ranged from 0.5 to 13 years, 3.68 on average.

Dizziness was the first main symptom reported and it was the reason for reporting to the Clinic. It was noted in 30 patients (90.90%). Dizziness was the most common (12 cases – 36.36%), rarely rotary vertigo (1–3.03%), sometimes both types alternatively (8 – 24.24%). The second most frequent symptom was headache, described as hemicranial or pulsatile. It was reported in 33 patients (100%).

The duration of headaches ranged from a few days to several minutes, most often several hours in repeated episodes 1–2 times a month.

On the other hand, a large percentage of patients reported dizziness lasting several seconds all the time (23 – 69.69%).

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Fig. 4. Smooth pursuit.

Fig. 5. Second phase nystagmus.
Abnormal saccades occurred in 6 people (18.18%). Smooth pursuit disorders were reported in 8 patients (24.24%). Asymmetrical optokinetic tracking was found in 14 patients (42.42%).

As regards rotary chair testing, apart from irregularity of the nystagmus in 8 patients (24.24%) and an increased nystagmus amplitude in 10 patients (30.30%), the duration of nystagmus was prolonged during rotation. Healthy people have a gradual decline of the angular velocity of the nystagmus in the rotary chair test after the chair has reached a constant speed. The time of nystagmus expiration is 30–35 seconds on average and it is extended in patients with vestibular migraine longer than 45 seconds. In the study group, this symptom was present in 15 respondents (45.45%).

An equally frequent abnormality was a bilateral, symmetrical vestibular hypersensitivity in caloric testing (confirmed in a rotary test) from 26.9 degrees/sec to a significant 62.2 deg/sec (average 41.03 deg/sec). This symptom occurred in 21 patients (63.64%) and was associated with abnormalities in rotary chair testing (irregular recording or increased nystagmus amplitude during and after rotation, or extended reaction time during rotation). No patients were diagnosed with canal paresis, and 5 (15.15%) had a relative directional preponderance.

In 19 patients (57.58%) a direction changing or non-changing positional nystagmus was also found (most often on the side and on the back). It was the only deviation in 2 patients, but more often it was accompanied by other abnormalities described above in VNG.

The following figures show the variations typical of vestibular migraine in VNG tests.

**DISCUSSION**

Diagnosing vestibular migraine is difficult for both neurologists and ENT specialists.

This interdisciplinary disease affects 1–3.2% of the population, but these numbers are likely an underestimate [1, 3–5]. The etiology is multifactorial and may be related to cerebral vasospasm and temporary brain hypoxia or with disturbance of CGRP and serotonin levels [6, 7]. Transient ischemia or asymmetric expulsion of neurotransmitters may involve the central vestibular pathways, in which case migraine-related (often unilateral) balance disorders can occur [4, 5].

In this study, over 90% of patients reported such symptoms. 72.73% of patients were hypersensitive to light, and another 36.36% – to sounds. Other symptoms reported by patients, typical of migraine, include hyperosmia, scotomas, paresthesia in the face or arms, nausea [4, 5, 8]. Vestibular migraine symptoms are therefore quite distinctive and a well-collected interview enables proper diagnosis. In all patients, abnormalities in videonystagmography were typically central without canal paresis [4, 5]. In most cases, there was no dysfunction in the VEMP study. Distinctive changes in the VNG helped to confirm the diagnosis. The most common deviation was vestibular hyperreflexia which occurred in 63.64% respondents (21 people). In the analyzed group, the excitability value ranged from 26.9 deg/sec to 62.2 deg/sec (average 41.03 deg/sec). Vestibular hypersensitivity is associated with an increased activity of the vestibular nuclei caused by a lack of cerebellar inhibition, which results in, e.g., an extended duration of nystagmus in the rotational test [9]. The time constant of the rotational response increases in
patients with vestibular migraine from 30–35 seconds to over 45, and is pathognomonic for this condition [10]. The velocity-storage mechanism also plays an important role here. This symptom was present in 15 respondents (45.45%) from the study group.

In 42.42% of patients, an irregular record of optokinetic tracking was noted. Optokinetic nystagmus is conditioned by the proper functioning of the structures in the cerebellum and the brainstem. It includes two components – tracking, associated with many structures of the CNS (especially with the cerebellum, brainstem, and the brainstem nuclei) and saccadic, e.g., rapid eye movement to the tracing starting point, generated in the reticular formation of the pons and the medial longitudinal fasciculus, and modified by cerebellar vermis and the flocculonodular lobe of the cerebellum [11, 12]. Among the patients diagnosed with vestibular migraine eye tracking impairment was recorded in 24.24% of cases (mostly a step-like record), and saccadic impairment – in 18.18% (in most cases hypermetry).

As for the rotational chair test, asymmetry of the nystagmus record during and after rotation to the right or left was found in 21.21% of respondents. There was second phase nystagmus in three cases (9.09%). It probably results from the increased activity of nystagmo-genic centers in vestibular nuclei in the absence of central inhibition.

The relative directional preponderance in the caloric test is another phenomenon related to the functional state of the central part of the vestibular system and was found in 15.15% of patients [9].

Despite the fact that the leading symptom is imbalance, only ¼ of the patients presented an abnormal posturography result (24.24%).

None of the subjects had canal paresis or hearing loss, however, there was a high percentage of patients with uni- or bilateral tinnitus, i.e., 51.52% without hearing loss and auditory pathway damage [13]. As for the coexisting diseases: sleep and mood disorder (18.18%), depression (12.12%), face and limbs numbness (9.09%), and restless legs syndrome (6.06%) were reported in the study [14].

CONCLUSIONS

1. The most common VNG abnormalities in patients suffering from vestibular migraine are: increased labyrinthine response, increased time constant of the rotational response and opto-kinesis disorder;

2. There was not a single case of canal paresis in the group of patients with vestibular migraine.
REFERENCES


