Regarding the Vestibular Infant Screening Flanders (VIS-Flanders) project – a critique

W sprawie skryningu niemowląt metodą przedsiomkowych potencjałów wywołanych z mięśni szyi VEMPu

ABSTRACT:
In 2019, an article on the introduction of Vestibular Infant Screening at the University Hospital of Ghent was published in the International Journal of Pediatric Otolaringology. The purpose of this critical review is to justify why cVEMP as a single test is neither reliable nor suitable for the diagnosis of vestibular defects, especially in infants. Another aspect is the costs incurred for such screening tests as VIS-Flanders significantly exceed the resulting social profit.

KEYWORDS:
hearing impaired children, neonatal hearing loss, Vestibular Evoked Myogenic Potential – VEMP, vestibular function, Vestibular Infant Screening

INTRODUCTION
In 2019, an article was published in the International Journal of Pediatric Otorhinolaryngology (120; 196–201) on the introduction of universal screening of the vestibular organ in hearing-impaired infant patients at the University Hospital in Ghent, Belgium [1]. The vestibular examination, called “Vestibular Infant Screening-Flanders” (VIS-Flanders), is the second phase of the Universal Newborn Hearing Screening Program (UNHSP). Cervical evoked myogenic potentials (cVEMP) are used to evaluate the labyrinth. It is performed in all infants diagnosed with hearing loss at 6 months of age. It is performed both in the case of sensorineural, as well as conductive or mixed hearing loss. The authors assume that early detection of labyrinth dysfunction will allow for an earlier introduction and improvement of the rehabilitation process. Researchers cite several studies that prove that vestibular dysfunction comorbid with hearing loss adversely affects both the motor and psychosocial development of a child.

We believe that the specificity for vestibular damage and the cVEMP retest reliability test in infancy are of too low a value to use this study in screening.

RATIONALE
The team from the University of Ghent chose the cervical atrial evoked cVEMP method to test vestibular function.
Vestibulocolic reflex biological tests, used to test cVEMP, begin with the stimulation of the saccule, as part of the vestibulum. The atavistic ability of the saccule, which was part of the cochlea in earlier stages of evolution, is used (it has retained the ability to respond to sound). Then the stimulus is conducted via the inferior vestibular nerve to the vestibular nuclei, and from there via the medial vestibulo-spinal tract to accessory nucleus, from where the motor cranial nerve XI innervating the sternocleidomastoid (SCM) and trapezius muscles originate [2]. Theoretically, damage to each of these components, and not just the saccule, could result in the lack of potential cVEMP in the study.

The test is performed at 6 months of age and, if there is no response in the first test, it is repeated within the next 3 months of life. The Authors of VIS-Flanders use bone conduction stimulus tone burst of 500 Hz, 123 dB HL intensity and 5 Hz stimulus repeatability [1].

For the characteristic biphasic response, an active (self-intentional) contraction of the sternocleidomastoid muscle is necessary [2–4]. The way SCM muscle contraction is enforced in the VIS-Flanders protocol can hardly be called an active contraction. The examiner moves the head passively, which may result in insufficient contraction of the muscle to build up the cVEMP potential. Despite the fact that VEMP is controlled by EMG, there is no data on the method and parameters of the electromyographic examination [1]. There is a considerable amount of controversy associated with EMG studies in patients at such a young age [5].

The normative data for VEMP are established for the age group between 20 to 75 years old, with good hearing [6]. Currently, no reliable standards have been established for a group consisting of hearing-impaired infants. The authors of the paper wrote “a bilateral two-peaked response within normative data”, but did not provide latency and amplitude values for a response to qualify as P1 or N1. There is also no source of this “normative data” mentioned in the article.

The authors of this critique recognize that stimulus intensity of 59 dB nHL in the VIS-Flanders nHL protocol must be a typographical error, where in fact it should be 95 dB nHL. An intensity of 59 dB nHL would be insufficient to elicit a response, despite the fact that cVEMP is assumed to be independent of the hearing level, in sensorineural hearing losses [7].

From the experience of the authors of this critique, the examination of infants and young children who are awake should be carried out promptly. The stimulus repetition rate of 5 Hz may be insufficient to obtain the appropriate number of reliable answers in a short time. The baby’s screaming or crying prevents the test from being completed. The difficulties associated with the lack of cooperation of such a young child make the test-retest reliability low.

It is also noticeable that, despite the fact that the stimulus is administered through the bone conduction route, in the case of conductive or mixed hearing loss, artifacts that prevent the registration of responses are more frequent. Middle ear fluid in case of conductive hearing loss may reduce sound intensity at the oval window and render VEMP responses unobtainable [7].

The laxity of the sternocleidomastoid muscle, and thus the lack of cVEMP, may be caused not only by vestibulocolic reflex receptor dysfunction; this may often be of central origin.

The team of authors from the University of Ghent using cVEMP for labyrinth studies has probably based their study on the assumption that if a dual-peaked response is not obtained, then there is a deficit in the saccule function.

Neither in the study by VIS-Flanders, nor in the literature cited by the authors, can we find any justification for such a thesis [1]. The lack of response from the saccule does not necessarily mean that the semi-circular canals or even the utricle are damaged at the same time.

Although in biological studies the cVEMP reflex arc begins in the saccule, there is no evidence of its clinical utility in detecting vestibular defects [8]. It is not known whether cVEMP responses accurately identify vestibular function specifically related to the saccule. The clinical value of c/o VEMPs is proven only in the detection of superior semi-circular canal dehiscence (SSCDs) [8–11].

In view of the above, the specificity of cVEMP for labyrinthine lesions is too low for this study to be used in vestibular screening.

There is no hard evidence in the VIS-Flanders project to support the theory that knowledge about the dysfunction of the labyrinth can significantly affect the course of the rehabilitation process and significantly improve its final result. Just as the value of universal neonatal hearing screening is indisputable today, the benefits of universal vestibular screening are controversial. Defects of the inner ear, due to the lack of a receptor in the vestibulo-spiral reflex, lead to a reduction in muscle tone, mainly in the neck and lower limbs, which implies appropriate neuro-rehabilitation procedures [12–13].
In the group of 60 patients tested by the authors of this critique, in the survey studies of motor development disorders, 9 out of 60 patients with congenital bilateral sensorineural hearing loss were found. In 7 of these children, the neurologist diagnosed damage to the central nervous system. None of these patients in this group provided reliable and reproducible cVEMP results when the study was performed in the first year of life. Appropriate rehabilitation procedures were undertaken in each hearing-impaired patient with a coexisting motor development deficit, regardless of the diagnosis of paralysis or vestibular paresis.

In the opinion of the authors of this critique, only the VOR gain measurement in the rotational chair test is a viable vestibular test in infancy.

The VEMP and VHIT (Video Head Impulse Test) tests are, in very few cases, possible to conduct at the end of 2 years of age, while the caloric test is rarely completed in children younger than 5 years of age [14].

**REFERENCES**


CONCLUSIONS

1. cVEMP does not meet the criteria of the vestibular screening test in infancy to low specificity and test-retest reliability [8];

2. The qualitative assessment of the labyrinthine function can only be made by the rotational chair test [11, 12];

3. The authors of this critique believe that the examination of the vestibular organ in infancy is cognitive in nature, and the diagnosis of impairment of the labyrinth until the introduction of vestibular prostheses will not have a significant impact on the management of a child with such a defect.

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