

# Concurrent ENG and VNG recording in healthy people – preliminary report

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## ABSTRACT:

**Introduction:** The aim of the work was to evaluate one-time recording of ENG and VNG in healthy subjects selected for the given diagnostic tests with reference to the sensitivity and usefulness of this kind of testing in vertigo diagnostics.

**Material and methods:** The tests covered 50 healthy subjects, including 24 women and 26 men aged 20-22 (the mean age of 20,5 years) who did not report any inconvenience from otorhinolaryngological organs and the conducted interview did not reveal any balance disorder or vertigo. Every patient underwent otoneurological subjective and objective tests, electronystagmography (ENG), including a calibration test, head-tracking test, optokinetic nystagmus test, rotatory chair test, positional tests according to Cawthorne and Rose, a Hallpike caloric test as well as videonystagmography which included a calibration test, spontaneous nystagmus evaluation, head-tracking test, positional tests according to Cawthorne and Rose with a head rotation test and Hallpike caloric test. The above tests were performed separately, 24 hours one by one. One-time recording of ENG and VNG was made 48 hours following the last test while each of the two tests was preceded by an additional calibration test. The final recording included the spontaneous nystagmus evaluation, positional tests according to Cawthorne and Rose together with the head rotation test and Hallpike caloric test.

**Results:** Any negative mutual influence of the conducted tests has not been observed. Both in the one-time and separate recording, the caloric test revealed lower values of the mean velocity of the nystagmus free phase in ENG with relation to VNG. No signs from spontaneous nystagmus, as well as optokinetic and positional nystagmus, could be found in any case.

**Conclusions:** The conducted tests did not show any possibility of mutual exclusion of the given ENG and VNG diagnostic tests one-time recording. However, their use in diagnostics of balance disorders and vertigo requires further studies

## KEYWORDS:

one-time recording of ENG and VNG, healthy subjects

## INTRODUCTION

Since the population incidence rates of vertigo remain unchangingly high, new studies are taken up constantly to unambiguously elucidate the underlying causes [1, 3, 4, 7]. The aim of diagnostic investigations is to determine the nature of the disorder and the circumstances of its development as well as to propose and initiate appropriate treatment. Due to the fact that proper function of the balance system depends on cooperation of multiple sensory organs such as the balance organ and the vision organ, the senses of exteroception and proprioception, the hearing organ and, to a lesser extent, the olfactory organ, diagnostic examinations performed in patients should be as extensive as possible [2, 8]. It is best to perform such examinations at a multispecialist hospital so that all the necessary

consultations and additional investigations may be performed in a short time span [6, 9]. Quite often, the scope of diagnostic examinations lies on the border between neurology and otorhinolaryngology, and further patient treatment is often supervised by neurology or neurosurgery specialists.

When introducing novel methods into the diagnostics of vertigo and balance disorders, one should ask themselves several questions, including whether new examinations would be better, more precise, and more reliable than those used to date, whether they would contribute to the diagnostic process, whether it would be shortened and whether the final diagnosis would be of better certainty [5, 13, 14, 15].

Older methods are not discarded; instead, the researchers com-

pare them to the new ones attempting to translate their past experience to the new equipment so that it may be used more efficiently. Results obtained by means of different methods should be in agreement and lead to identical conclusions in different trials. This is required to assume that the measurements were done correctly and the results are reliable.

The aim of the study was to evaluate concurrent recording of ENG and VNG measurements in selected diagnostic tests in healthy subjects so as to explore potential sensitivity and applicability of this kind of testing in the diagnostics of vertigo.

## MATERIAL AND METHODS

The study was carried out in 50 healthy subjects including 24 women and 26 men aged 20-22 (mean age of 20.5 years) reporting no otorhinolaryngological organ-related complaints and no history of any balance disorders or vertigo.

Every patient underwent subjective and objective otoneurological tests, electronystagmographic (ENG) examination including calibration, head-tracking test, optokinetic nystagmus test, rotatory chair test, positional tests according to Cawthorne and Rosen, and Hallpike caloric test as well as videonystagmographic (VNG) examination which included calibration, spontaneous nystagmus evaluation, head-tracking test, positional tests according to Cawthorne and Rosen with neck rotation test, and Hallpike caloric test.

The caloric test was performed using a HOMOTH air calorimeter with the air at the temperatures of 30°C and 44°C being delivered for 40 seconds to the external auditory meatus after any pathologies of the external auditory meatus and the middle ear had been excluded.

At first, the aforementioned ENG and VNG examinations were carried out separately at a 24-hour interval. Concurrent ENG and VNG recording (Fig. 1) was carried out 48 hours following the last test, with calibration being performed again before both evaluations.

The concurrent recording included the spontaneous nystagmus evaluation, positional tests according to Cawthorne and Rose with the neck rotation test, and Hallpike caloric test.

Recording was achieved by means of computer systems for electronystagmographic and videonystagmographic analysis which facilitated calculation of decreased labyrinth excitability, relative directional preponderance, maximum velocity and frequency of the nystagmus slow phase. In the case of VNG,

the software additionally determined the absolute directional preponderance and reflectivity to assess the impact of the central nervous system on the labyrinth [14].

## RESULTS

No negative mutual interference of the conducted tests has been observed. Both in the concurrent and in the separate recordings, the caloric test revealed lower values of the mean velocity of the nystagmus free phase in the ENG test as compared to the VNG test. No signs of spontaneous nystagmus, as well as no signs of optokinetic and positional nystagmus, were detected in any case.

## DISCUSSION

Direct observation and evaluation of ocular movements is the oldest method for the assessment of nystagmus [8]. However, the method is sometimes inaccurate and may be negatively affected by a number of factors such as fixation. Since elimination of the fixation reflex required closing the eyelids and thus precluded direct observation, attempts at determining nystagmus consisted in investigator's fingertips being placed on subject's eyelids so as to sense the movements of eyeballs. Bartel's spectacles and Frenzel's goggles were developed with the aim of eliminating the fixation reflex without the need for eyelid closure; these facilitated observation of eyeballs at magnification of +20 D. On the other hand, the method was inappropriate for determination of certain nystagmus parameters such as amplitude and frequency, not to mention the most important parameter, i.e. the slow phase. This was enabled only after introduction of Schott's apparatus in 1922 [2, 8].

The first devices were modified electrocardiographs which recorded the electrical signals generated upon eyeball movements at appropriately affixed electrodes. After the recording was obtained, the examining physician summarized the appropriate parameters and drew appropriate conclusions.

A breakthrough came with the introduction of computers which could be used to record data and calculate the nystagmus parameters. However, one of the drawbacks of this method consisted in the lack of the ability to record rotatory nystagmus. This problem was solved only following the new examination method of videonystagmography being introduced by Ulmer in 1989. The method consists in direct observation of eyeballs using the camera without the inhibitory impact of fixation reflex. The examination data are gathered in the computer's memory, and the parameters of nystagmus are evaluated by means of special software.

In medical practice, examinations are usually continued using older methods, with smooth transition into newer methods occurring after some experience is gained in the new technique and the assessment of results obtained therewith. If a single patient is to be examined using both methods, the second examination is performed after a certain time interval has elapsed from the first one. However, such a time interval may lead to a change in examination parameters due to patient's fatigue and adaptation to stimulation.

Previous comparative studies [12] in which the examinations were performed at intervals of 7 days, higher mean velocities of the slow phase of nystagmus were observed in VNG examination as compared to ENG examination. In addition, the analysis of absolute directional preponderance in the VNG examination led to a significant increase in the results of Hallpike caloric test.

No negative mutual interference of the conducted tests has been observed. Both in the concurrent and in the separate re-

cordings, the caloric test revealed lower values of the mean velocity of the nystagmus free phase in the ENG test as compared to the VNG test.

The authors consider this a preliminary report which requires confirmation in further studies conducted in a much larger population, particularly in patients with balance disorders and vertigo.

## CONCLUSIONS

1. The conducted tests did not reveal any mutual excludability between the selected ENG and VNG diagnostic tests upon concurrent recording. However, the concurrent use of both examinations in the diagnostics of balance disorders and vertigo requires further studies.
2. The values obtained for the mean velocity of the slow phase of nystagmus are suggestive of a much higher sensitivity of VNG as compared to ENG.

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