Article / Clinical case

Features of Vestibular Changes in Patients with Vestibular Schwannoma. Historical Background and the Current State of the Problem.

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Abstract: The problem of vestibular disorders is one of the most urgent in the practice of a neurologist and otorhinolaryngologist. Dizziness patients can also ask for help specialists of any profile. Typical complaints require to conduct an appropriate examination and prescribe treatment. Due to the acute manifestation and rapid progression of symptoms, the patient's quality of life is significantly decreased and the ability to work is impaired. Vestibular disorders are even increased with age. Among the elderly, such complaints presented in about 48% of patients, almost every second one. Depends on the cause, vertigo can be of peripheral (otological), central and functional (psychological) origin. Often, the patient's condition assessed as serious and required immediate medical manipulations. For this reason, any specialist, to whom patient complains of dizziness, must be able to competently conduct an examination and perform the most complete examination. However, the lack of uniform standards for vestibular testing can lead to diagnostic errors and the choice of incorrect medical tactics. The article provides an overview of the literature data on the examination of patients with complaints of dizziness. An integral part of the diagnostic search for dizziness is the collection of complaints and anamnesis, a standard otorhinolaryngological examination, as well as audiometric and vestibular otoneurological tests. There is not much literature about vestibular testes in patients with vestibular schwannomas, here in this paper we present the literature dats and our experience in this topic.

Keywords: vertigo, dizziness, vestibulometry, computed videonystagmography, caloric test, vestibulometry, video head impulse test, acoustic neuroma, vestubular schwannoma.

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1. Introduction

Dizziness is one of the most common reasons for seeking medical help. Patients with vestibular disorders are found in the practice of a doctor of any specialty [1]. It is reported that 15-30% of the adult population experience debilitating symptoms of dizziness and balance disorders, which are accompanied by the risk of falling as the most frequent and alarming consequence. With age, vestibular manifestations increase, and the frequency of their occurrence in women is 2-3 times higher than that in men. Among the elderly, such complaints are made by about 48% of patients, namely, almost every second. Depending on the cause, dizziness may be of peripheral (otological), central and functional (psychological) origin [2].

Often vestibular disorders are acute. Dizziness can be accompanied by nausea, vomiting, intolerance to head movements, the appearance of nystagmus, instability when walking and balance disorders. The symptoms of peripheral and vestibular dysfunction partially coincide, and only a thorough history collection and a comprehensive physical examination help to conduct a qualitative differential diagnosis. Thus, the most common form of acute peripheral vestibular dysfunction is vestibular neuritis. In 25% of cases, the causes of severe imbalance of central origin are ischemic stroke of the posterior cranial fossa and demyelinating diseases [3].

The lack of standardization of vestibular testing can lead to diagnostic errors and incorrect choice of patient management tactics. In addition, it should be noted that most neurological and ENT rooms do not have sufficient equipment for the most qualitative and complete vestibular testing. Prolonged diagnosis due to prolonged examination of a patient with dizziness not only worsens his quality of life and leads to disability, but is also dangerous from the point of view of a possible rapidly developing severe pathology up to a threat to life.

2. Purpose: to highlight the historical aspects and the current state of the problem of examining patients with complaints of dizziness and share their own experience.

3. Results

An integral part of the diagnostic search for vertigo is the collection of complaints and anamnesis, standard otorhinolaryngological examination, as well as audiometric and otoneurological tests. To systematize and objectify complaints detected in patients with vestibular disorders, various scales, tests and questionnaires were created. The most common of them are the "Vertigo and Mnestic Functions Assessment Scale" (DHI), the "International Classification of Functional Disorders" (ICF) and the Karnowski Index [4, 5].

Often vestibular disorders are accompanied by tinnitus and hearing loss, which can serve as one of the criteria for diagnostic search. For this reason, a qualitative surdological study is necessary, which consists in assessing the indicators of tonal threshold bone and air conduction and conducting tuning fork tests. For example, in vestibular schwannoma, the intelligibility of spoken speech in the affected ear is usually markedly reduced, does not always correlate with the size of the tumor and may be disproportionate to the measured degree of hearing loss [6]. Interestingly, the absence of unilateral sensorineural hearing loss is not a reason to exclude the diagnosis of neoplasm: scientists describe at least 4.2% of cases of large acoustic neurinoma that do not affect hearing acuity [7].

Before the widespread use of magnetic resonance imaging, tympanometry, impedance audiometry and the Bekeshi test were considered to be among the most accurate methods of diagnosing cochlear pathology. Despite the limited accuracy of the research results, they allow us to assume the presence of the disease, the possible level of lesion and determine the further tactics of the patient's management. The most diagnostically valuable are the results of the study of auditory evoked potentials, which can be used as an additional screening measure in patients with unilateral hearing loss. In the latter case, magnetic resonance imaging makes it possible to indicate with maximum accuracy whether the symptoms are caused by brain neoplasm, circulatory disorders or some other cause [8, 9].

The safety of the function of the vestibular analyzer and cranial nerves is checked in the process of otoneurological examination. The corneal reflex, sense of smell, skin and taste sensitivity, chewing muscle tone, pharyngeal reflex, swallowing, phonation, facial expressions are evaluated [10, 11, 12]. Vestibular examination includes checking oculomotor reactions, as well as stato-coordination and statokinetic tests. The sampling should be carried out taking into account the general well-being of the patient. The study should be stopped immediately in case of a sharp deterioration of the patient's condition and provide him with the necessary assistance. With regard to the diagnosis of developing vestibular schwannoma, it should be remembered that dizziness may be the only symptom even if normal indicators recorded during audiometry are maintained.

When checking oculomotor reactions, the presence of spontaneous nystagmus, its direction, and the change in intensity in the absence of eye fixation are evaluated [12]. To exclude focusing on any subject, N. Frenzel in the middle of the 20th century proposed a device consisting of a combination of magnifying glasses and a lighting system that allows detecting eye movements better than with traditional examination [13]. With the help of N. Frenzel glasses, it is possible to register a hidden nystagmus. The doctor can also detect it without this device with the patient's upper eyelids closed by placing fingers on them and catching rhythmic eye movements. However, such a technique significantly limited the researcher in describing the characteristics of spontaneous nystagmus. In addition, rectangular saccadic oscillations can be detected in this test, the direction of which is not determined due to the almost equal deviation of the eyeballs by 0.5-5 degrees in both directions. These symptoms can be observed in smokers, with severe psychoemotional stress, progressive supranuclear paralysis of the eye and some cerebellar syndromes [12, 14].

Devices similar to N. Frenzel glasses have been proposed and improved by many scientists studying nystagmus [15-18]. The concept of the level of damage to structures is given by differential diagnosis of peripheral and central nystagmus, as well as an assessment of the preservation of the function of oculomotor systems – optokinetic, vestibular, saccades, smooth tracking [19]. Available methods for examining a patient with complaints of dizziness are caloric and rotational tests. These diagnostic methods are convenient to use as screening methods, since they suggest a violation of the function of the peripheral part of the vestibular analyzer without its quantitative assessment. Statocoordination and statokinetic tests (Romberg, index, Fischer-Vodak, marching) they can also be carried out during routine examination and are most informative in acute developing processes. At the same time, they have low information content in chronic diseases that

cause dizziness, due to compensation at the expense of the healthy side (for example, in long-term developing tumors) [20, 21].

Modern scientific approaches and technical capabilities have defined a new direction in the diagnosis of vestibular dysfunction using computer technology. Thus, static and dynamic equilibrium is studied using computer stabilometry, which allows not only to quantify the function of the vestibular analyzer, but also to store data in electronic form with the possibility of subsequent dynamic observation [21]. Electronystagmography is also widely used to examine a patient with dizziness. With the help of this technique, the movements of the eyeballs are graphically recorded, and according to the results obtained, it is possible to objectively evaluate the work of the vestibular analyzer. In addition, electrostagmography, being one of the most convenient and accessible approaches, is recommended for examination not only of adults, but also of children as the most gentle method of diagnosis, including in the absence of obvious otoneurological symptoms [22]. Electrooculography and video oculography are similar to this technique, with the help of which not only the fact of the presence of nystagmus is recorded, but also the movements of the eyeballs are recorded in order to allow their further detailed analysis [21].

One of the most modern, accurate and informative methods for assessing vestibular function is computer videonistagmography. The technique is characterized by high sensitivity and specificity and consists in a comprehensive objective automated analysis of oculomotor reactions, caloric and rotational tests. A significant advantage of this method is the ability to fix disorders of the function of the vestibular analyzer at the subclinical stage before their manifestation. Computer videonystagmography can be used to assess neurological dynamics in patients with neoplasm of the place-cerebellar angle before and after surgical and radiosurgical treatment, as well as during conservative therapy [23, 24].

The data of audiometry and otoneurological tests, which make it possible to identify a violation of vestibular function and to assume a probable pathological process, must necessarily be compared with neuroimaging methods for the most accurate diagnosis. In particular, such a technique is magnetic resonance imaging with a high degree of resolution (1.5 Tesla). If there is a suspicion of the formation of a place-cerebellar angle (in particular, a vestibular suture), contrast enhancement is used, in particular gadolinium. This method makes it possible to most accurately determine the size and localization of the tumor, its relationship with nearby structures, the presence of a cystic component. Magnetic resonance imaging with a low degree of resolution (0.2 Tesla) it also allows you to visualize a neoplasm (in particular, neurinomas less than 2 cm in size). However, for the most accurate diagnosis, preference should be given to a study with a high degree of resolution and contrast should be used [25, 26].

Computed tomography in bone mode also has sufficient information. In particular, according to the results of this study, in patients with acoustic neurinoma, the expansion in the area of the external auditory canal is visualized, as well as the anatomical topography of the structures of the temporal bone. However, neuroimaging methods, despite the highest accuracy and specificity, are still not routine, due to the high cost and the need for appropriate equipment, and with frequent use they are associated with the risk of increased exposure [27]. However, magnetic resonance imaging is recognized as the "gold standard" for the diagnosis of organic pathology of brain structures and should be prescribed if a disease of the central nervous system is suspected, which the doctor could assume according to other studies. For example, when treating patients with vestibular schwannoma as a screening method, preference should be given to magnetic resonance imaging performed in the turbo spin-echo mode, which has high sensitivity (100%), specificity (96%) and has not shown a single false negative result. In addition, this method is non-invasive and less expensive compared to contrast examination, which can always be performed to clarify the diagnosis and in case of complications [28].

Thus, due to the variety of conditions that cause dizziness, including an acutely developing pathology that poses a direct threat to life, at each stage of diagnosis, the patient needs a universally accessible and most detailed examination. However, at the stages of examination preceding neuroimaging, the search for the cause of dizziness may cause difficulties in correlating clinical manifestations with the alleged focal pathology. Due to the high specificity, accuracy, and accessibility, the use of KVNG at various modern diagnostic levels will optimize and make it economically more profitable to recognize the causes of dizziness, determine further tactics for managing patients with dizziness and monitor the course of treatment of the disease in dynamics.

4. Clinical case

As an example, let's give a clinical case. The otoneurologist was contacted by patient V., a 53-year-old man, complaining of dizziness, noise in the left ear, hearing loss on the left. The patient noted the first manifestations about six months ago, however, she did not attach importance to

the symptoms. During the last month, the dizziness intensified, which significantly affected performance, and the patient sought medical help at the polyclinic, from where he was referred to an ENT doctor, a surdologist and an otoneurologist. During a standard otorhinolaryngological examination, no data for acute ENT pathology were revealed. According to the results of audiometry, chronic sensorineural hearing loss of the left II degree was diagnosed.

As a screening otoneurological test, vestibulometry was performed using the VO 425 Interacustic device (Denmark). The technique consists in the automated diagnosis of labyrinthine hyporeflexia, which was recorded when performing the test of impulse movements of the head. To conduct the study, the patient wore special glasses equipped with cameras and illumination, ensuring the impossibility of focusing the gaze. The data obtained during the tests were processed using a standard program and displayed on a personal computer screen in the form of graphs and numerical expressions characterizing the operation of each semicircular channel. This study is the only one in the world that provides the fastest detection and assessment of the degree of damage to the vestibulocular reflex in response to stimuli in the high-frequency range, which is natural for head movements, simulating daily activity. The indisputable advantage of conducting vestibular testing using this device is its greatest comfort for the patient (sufficient speed of head pulses is provided even when turning no more than 20 degrees), as well as accessibility, maximum accuracy and speed of complex interpretation of the results.

Otoneurological examination of patient V. revealed the absence of spontaneous nystagmus, as well as pathological changes in the vestibulocular reflex and in the tangential deviation test. However, according to video pulse testing, hyporeflexion of the lateral and posterior semicircular canal on the left and the anterior semicircular canal on the right was noted (Fig. 1).

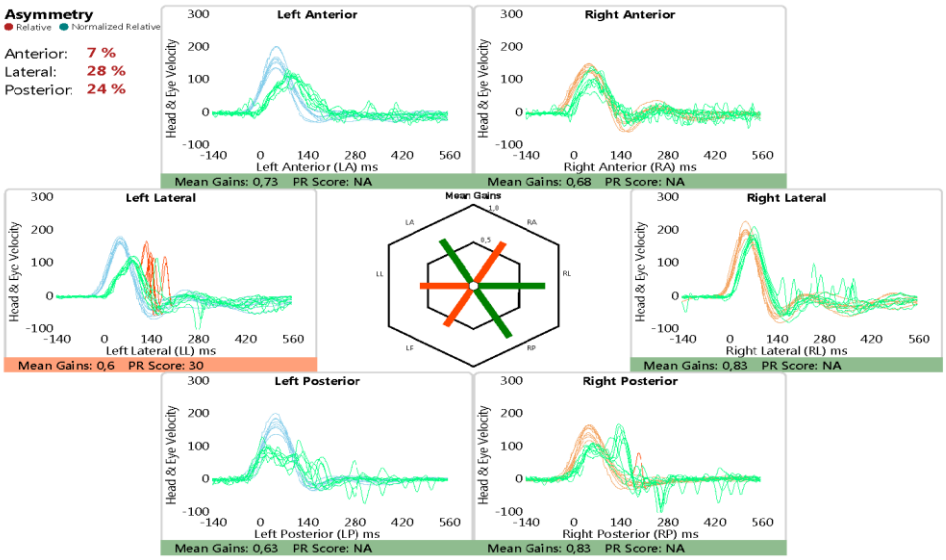

Figure 1. Graphical representation of the responses of semicircular channels to high-frequency stimuli.

The data of the video pulse test demonstrate peripheral vestibular disorders on the left, with satisfactory central compensation. To clarify the diagnosis, patient V. underwent magnetic resonance imaging, which showed the presence of a developing neoplasm of the vestibulocochlear nerve on the left (vestibular schwannoma) (Fig. 2).

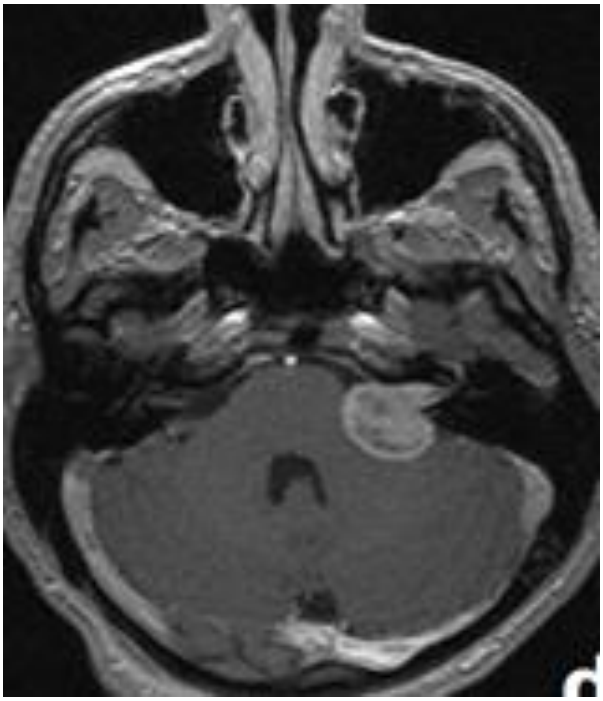

Figure 2. MRI in T1-weighted mode of patient V. 53 years old.

In the area of the internal auditory canal on the left, with a spread to the place-the cerebellar angle, an unevenly accumulating contrast agent is detected, with clear, even contours, up to 2.5 cm in diameter, presumably vestibular schwannoma.

Further tactics of examination and treatment For follow-up and therapy were explained to the patient. Patient B. was referred for consultation to a neurosurgeon and a neuroradiologist to resolve the issue of the possibility of radiohirrug treatment or the feasibility of surgical removal of the tumor.]. PBM therapy [7, 8, 17 - 19]...

5. Conclusions

Thus, vestibulometric examination of patients with complaints of dizziness is timely, accurate and allows to determine the presence and degree of peripheral vestibular pathology. An integrated approach to the diagnosis of the pathological process provides a competent definition of further management tactics for patients with vestibular dysfunction, and in particular patients with vestibular schwannomas, which avoids severe complications and prolonged disability.

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The use of artificial intelligence: the article is written without the use of artificial intelligence technologies.

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