REVIEW ARTICLE

CONTENTS

The phenomenon of accelerated volume growth and a critical analysis of the interpretation of the mechanism of its occurrence

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ABSTRACT

Aim: To reveal the peculiarities of the phenomenon of accelerated volume growth and to analyze the interpretation of the mechanism of its occurrence.

Materials and Methods: This phenomenon was observed in cases of impaired receptor or root of the auditory nerve, or some central acoustic formations. In case of impaired root, this event occurs in 50 per cent of the patients, and therefore the symptom cannot be regarded as a reliable indication of the cochlear or root lesion.

Conclusions: The phenomenon of accelerated increase in volume as one of the manifestations of irritation symptoms is also most pronounced in peripheral lesions. In tumours of the auditory nerve, the function is impaired, but the irritation is absent. The relatively high frequency of this symptom attendant on peripheral lesion is rooted in the fact that impaired reception manifests itself most conspicuously in the irritation of the auditory nerve, while the central nervous system is not affected, and the patients are able to detect the direction from whence the sound comes.

KEY WORDS: the phenomenon of accelerated increase in volume, auditory nerve, affected receptor, vestibular analyzer, topic-morphological theory

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INTRODUCTION

Sound volume is important in the study of hearing pathology. The recruitment phenomenon is used to differentiate between cochlear and retrocochlear hearing loss. Kok Wooi Teoh, Khurshid Merchant, Josephine Swee Kim Tan, Henry Kun Kiaang Tan, Juin Yee Kong [1-6] drew attention to the fact that this phenomenon is positive when the spiral organ is damaged, and negative when the auditory nerve root is damaged. With a positive FAVG in the affected ear with reduced hearing, there is an increased sensitivity to loud sounds, and this ear acutely perceives the increase in sound intensity.

There are many methods of detecting FAVG. They include the study of loudness balance according to Fowler, the determination of the amount of direct and reverse adaptation, the measurement of differential thresholds of sound power perception according to Luscher, noise audiometry according to Langenbeck, the study of the amplitude of oscillations when recording a curve on an automatic audiometer, the study of the SISI test, and so on.

AIM

The aim of the article is to reveal the peculiarities of the phenomenon of accelerated volume growth and to analyze the interpretation of the mechanism of its occurrence.

MATERIALS AND METHODS

The explanation of PAVG is based on the topical and morphological theory [6], according to which a positive PAVG is associated with a lesion of the receptor apparatus in the cochlea, and a negative PAVG is associated with a retro cochlear lesion. These authors explain the appearance of positive PAVG in tumors of the VIII pair of cranial nerves by the compression of the labyrinth artery, which causes a secondary effect on hair cells.

Y. Matvienko [3] considers the loss of function of the lateral sensitive cells of the spiral organ while the medial cells are preserved as the cause of the appearance of PAVG. Lateral sensory cells perceive weak auditory stimuli, and medial ones – stronger ones.

However, as experience accumulated, there was disappointment in the topical value of this phenomenon, since positive PAVG occurs during overexertion in healthy people with normal hearing and passes after rest. When analyzing a large number of observations with hearing loss of root and central origin Pyatykop V.O., Tovazhnyanska O.L., [4, 5], Matvienko Y.O., Negrych T.I., [3] found in some positive PAVG in some cases. In the process of observation, a positive PAVG can change to normal and even negative [2, 6, 7]. When analyzing a series of

observations of neuron VIII of a pair of cranial nerves with partial preservation of hearing for tumors, a positive PAVG was established in 50% [3, 7]. Therefore, with a root lesion in half of the observations, a positive PAVG is noted, so this symptom cannot be considered a sufficiently reliable differential diagnostic sign of a cochlear or retro cochlear lesion. A significant role in the differentiation of cochlear and retro cochlear hearing loss Andreev O.A. [1] refers to the peculiarities of sound lateralization in Weber's experience: with unilateral cochlear deafness, sound in Weber's experience is lateralized to the better ear, and with retro cochlear deafness and even deafness, sound lateralization in Weber's experience is absent in 80%. This is the main symptom for the differentiation of cochlear and retro cochlear sensorineural deafness.

In contrast to the topical and morphological explanation of PAVG, many authors put forward a physiological interpretation of this phenomenon. Thus, Kok Wooi Teoh, Khurshid Merchant [6] associates a positive PAVG with a special irritation functional state of the VIII pair of cranial nerves, close to hyperacusis, and a phase phenomenon in the auditory analyzer. Some authors believe that a positive PAVG reveals not only the topic of the lesion, but also the functional relationship between excitatory and inhibitory processes. Yes, Andreev O.A. [1], without denying the morphological theory of PAVG, believes that this symptom can be attributed to phase phenomena in the auditory analyzer.

In today's conditions of rapid technical progress, more and more new audio logical threshold tests are offered, which quickly replace each other, but later become disappointed in them.

What is the reason for the restrained attitude of many authors to supra threshold tests? This attitude, in our opinion, is connected with many factors.

The main reason for the inconsistency of the data obtained during supra threshold tests is explained by the fact that these tests are in most cases explained from morphological positions, while, in our opinion, the basis of PAVG lies in peculiar functional changes of the auditory analyzer with a predominance of irritation phenomena close to hyper accuses and phase phenomena in the auditory analyzer, as well as changes in the functional state of the central nervous system.

Different methods of studying PAVG are used, which study different physiological qualities of the auditory analyzer and the central nervous system. In this regard, it is possible to obtain ambiguous and often directly opposite data about PAVG with different research methods. We believe that the most adequate way to study PAVG is the Fowler method, while the most objective study is on an automatic audiometer with the study of the amplitude of oscillations on the audiogram.

To explain PAVG in the literature, only the level of damage to the auditory analyzer is mainly taken into account, and not its functional state in each specific disease (significant prevalence of symptoms of irritation in Meniere's disease, especially in its initial phases) and a clear prevalence of the destruction phenomena of the loss of auditory function, in neuromas VIII pairs of cranial nerves.

When evaluating FAVG, only the state of the auditory analyzer is often taken into account without analyzing the general functional state of the central nervous system. At the same time, all various tests for the study of PAVG are associated with the patients' performance of very fine differentiations, which are ensured only under the condition of high functional activity of the central nervous system.

On the basis of theoretical analysis and observations of studies of PAVG by various methods (by the magnitude of oscillations of the tonal audiogram on an automatic audiometer, the Luscher method, research of the SISI test), we came to the conclusion that a positive PAVG can be observed both with cochlear and with root and central lesions auditory pathways and nuclei. Negative and sharply negative PAVG in the case of disorders in the central nervous system is caused not so much by the defeat of the auditory analyzer as by a change in higher nervous activity in these patients.

Positive PAVG is most often manifested in pathology, when it is dominated by irritation phenomena in the auditory analyzer. As the auditory function fades, irritation phenomena disappear, the positive PAVG turns into normal and even negative.

The high frequency of positive PAVG in peripheral lesions is partially due to the fact that all symptoms of irritation in the auditory and vestibular analyzers are especially clearly manifested in disorders of the receptor apparatus (sharp painful noises, severe dizziness, which can even lead patients to suicide). PAVG as one of the manifestations of irritation symptoms is also most pronounced in peripheral lesions.

In our opinion, PAVG is not so much related to a certain topic as to a special functional state of the cochlear portion of the VIII pair of cranial nerves.

In Ménière's disease, which affects hair cells, this phenomenon is usually positive, and in the case of a root lesion – neurinomas – it is more often negative. However, one cannot ignore the fact that, in addition to the different topic (with Meniere's disease and neurinomas of the VIII pair of cranial nerves), the auditory nerve in these two diseases is in completely different functional states. With neurinomas, the symptoms of loss with slow and gradual fading of the functions of the VIII pair of cranial nerves significantly prevail. Symptoms of irritation are either absent or slightly expressed (hy-

per accuses, dizziness, as a rule, are absent, there is no noise or it is weakly expressed). In Ménière's disease, symptoms of irritation of the vestibular and auditory portions of the VIII pair of cranial nerves (hyper accuses, loud noise, especially during an attack of vestibular vertigo) predominate.

REVIEW AND DISCUSSION

Our observations convincingly indicate that PAVG is associated not only with the level of damage, but also with a certain functional state in the form of hyperacusis.

With hyperacusis, patients perceive even weak and stronger sounds excessively acutely. Most often, hyperacusis occurs during the acute development of the process, and especially often – during Ménière's disease. Some clinicians have previously associated hyperacusis with a specific topic. Our observations showed the fallacy of this opinion. Hyperacusis occurs when the auditory analyzer is damaged at various levels (on the periphery, in the area of the optic tubercle). It is a peculiar functional state of the VIII pair of cranial nerves, which cannot be given only topical significance. In a number of observations, it can obviously be attributed to phase states.

Hyperacusis is of great importance in the appearance of PAVG. It is well known that hyperacusis is particularly common in Ménière's disease. In addition, along with a positive PAVG, the pain threshold often decreases at the same time. All this indicates a peculiar functional state of the VIII pair of cranial nerves with the manifestation of heightened auditory sensitivity.

Theoretical analysis and observations indicate that, in a particularly strongly expressed form, positive PAVG is determined in the case of an irrigative form of damage to the VIII pair of cranial nerves, and over time when the function of the VIII pair of cranial nerves fades; when the phenomena of irritation in the auditory nerve decrease, PAVG may disappear. Our assumption is confirmed by the research of Matvienko Y.O., Negrych T.I., Marienko L.B., Korol H.M. [3], who studied PAVG in the dynamics of Meniere's disease and found that over recruitment could turn into a normal phenomenon, and later it became negative. Yu.O. Matvienko [3] believes that the receptor otoneurological syndrome can sometimes be observed with a negative PAVG. One cannot consider this phenomenon statically, as some authors do. We believe that a positive PAVG in Meniere's disease does not mean that this phenomenon is due to the damage of only hair cells.

Based on the general physiological patterns of the activity of the nervous system, perhaps it should be assumed that this phenomenon can occur with lesions in different areas of the auditory analyzer, but it is most often and clearly manifested in Ménière's disease. Moreover, this manifestation depends not so much on the level of the lesion, but on the extreme peculiarity in the course of Ménière's disease, because in this disease, irritation in the auditory and vestibular analyzers is especially pronounced.

Theoretical analysis of research and our observations show that increased sensitivity to accelerated loudness is easier to detect in peripheral lesions, since in such patients the central parts of the nervous system and higher nervous activity are mostly unchanged, patients give clear responses to changes in sound intensity.

With a central lesion in patients, higher nervous activity is often disturbed, the possibility of accurate and clear differentiation becomes difficult not so much due to local damage to the auditory analyzer, but due to general brain disorders and the predominance of inhibitory processes in the central nervous system.

Our theoretical analysis of literary sources allows us to assert that the explanation of PAVG only from topical positions reflects a fascination with morphology, the desire to assign each symptom to a specific topic, insufficient knowledge of the main physiological patterns in the activity of the nervous system, and the desire to explain everything only by changes in the peripheral part of the analyzer of its role.

Despite the fact that, in our opinion, PAVG is not associated only with the topic of hair cell damage, we believe that this phenomenon is of some importance in the differential diagnosis between neuromas of the auditory nerve and Meniere's disease, since it is observed in Meniere's disease more often However, the basis of the mechanism of this phenomenon is different functional states of the VIII pair of cranial nerves in Ménière's disease and in neurinomas of the VIII pair of cranial nerves.

The increased sensitivity of the VIII pair of cranial nerves, which is inadequate in terms of the strength of the stimulus, leads to an increase in sound intensity and can most likely be considered as a phase phenomenon in the auditory analyzer.

CONCLUSIONS

A positive PAVG is observed when the receptor, the root of the VIII pair of cranial nerves and the central auditory formations are affected. With a root lesion, a positive PAVG is observed in 50%, so this symptom cannot be attributed to reliable differential diagnostic signs of a cochlear or root lesion.

PAVG is associated with functional changes in the auditory analyzer, it is one of the symptoms of irritation, close to hyperacusis and a phase condition in the auditory analyzer, when at a certain intensity, sounds have an overpowering effect.

The frequent detection of positive PAVG in Meniere's disease is not so much related to the topic as to the prevalence of irritation in the auditory and vestibular analyzers, especially in the acute phase of this disease. In tumors of VIII pairs of cranial nerves, the phenomenon of loss of nerve function without irritation phenomena prevails.

The relatively higher frequency of positive PAVG in peripheral lesions is due to the fact that in the case of receptor disorders, the symptoms of irritation in the VIII pair of cranial nerves (loud noises, dizziness) are particularly clearly manifested and, in addition, patients retain the possibility of accurate differentiation in connection with lack of damage to the central nervous system.

Sharply negative PAVG with lesions of the central nervous system in many patients is caused not so much by a violation of the auditory analyzer as by a change in higher nervous activity.

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CONFLICT OF INTEREST

The Authors declare no conflict of interest

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