Pathogenesis and treatment of tinnitus in patients with dental disorders

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Abstract
Tinnitus is a term used for auditory perception of sounds in the absence of surrounding sounds. It can manifest as an only symptom or as a component of an otovestibular complaint. It can be an important symptom of impaired hearing, vertigo, distortion of sound, pressure or pain in the ear, etc. Tinnitus is not considered as an exclusive disorder anymore, more so as an expression of neural plasticity of multisensory neurons to changes in their external environment. It is commonly associated with anxiety and depression. There are multiple methods of testing tinnitus and the treatment proves to be very difficult, as well as etiologically defined and complex.

Introduction

The term tinnitus comes from the latin word for ringing – „tinnere“. The auditory perception for tinnitus includes buzzing, whistling, rumbling or humming. It can be high or low frequency, acute or chronic, rhitmic or pulsing. It can occur onesided or in both ears. Depending on its ability to hinder work capacity it can be compensated or decompensated. Tinnitus can also appear as a synchronized sound to heart beating and breathing. It can cause headaches, anxiety, depression. Differential diagnosis for tinnitus is sound hallucination, which is a symptom for psychological disorders. Having low noise tolerance and hyperakusis can accompany tinnitus. Hyperakusis patients tend to complain from discomfort in different sound perception and high noses. Hyperakusis is to be differentiated from recruitment, which is a perceprion of very fast increase of sounds. (1)

Pathogenesis and etiological factors

The origin of tinnitus is considered to be in the central auditory canals and the auditory part of the brain. To put evidence to this theory, researchers have experimented by using electrophysiological examinations to conduct a map of the neuronal activity in the brain using neuroscaning. Brain

activity has been monitored for patients with induced tinnitus. (2) The research shows high intensity of engagement in the auditory canals and their connection to the cochlear dysfunction of the tinnitus patients. 1000 patients took part in the research. They are in the age interval of 30-45 years and have had chronic tinnitus for at least 5 years. (3) The results show change in the auditory efference and cochlear dysfunction as a stimulus for the intensity of the tinnitus. The functional MRI shows activity of the auditory part of the cortex, the cochlear nuclei and the colliculus inferior. (8)

The limbic system in the examined patients is also affected. (3) There is a pathological connection between tinnitus and emotional disorders such as anxiety and depression, as well as insomnia. The neurophysiological model shows two ways connecting the auditory analisator with the limbic system and the autonomous nervous system. The activity of symmetrical parts of the autonomous nervous system, which are responsible for negative noise induced reactions, can be induced from the upper or lower neurous bundle. When there is chronic tinnitus, the activity of the autonomous system is induced by the lower bundle (the unconscious). When there is acute tinnitus, the dominant activity is of the upper bundle – the conscious. (4,5)

The somatosensor system is also connected to tinnitus according to a lot of clinical evidence. Somatic modulation is often the reason for change in the characteristics of tinnitus. Tinnitus can also be caused by protrusion and dislocation of the mandible. There are neuron connections between the two cochlear nuclei, colliculus inferior and ganglion trigeminale and the auditory zone of the cortex. Functional MRI of the cental part of the auditory analisator can register the effect of the somatosensory system on the auditory system and the appearance of tinnitus. The somatosensory impulse induces irritation of the auditory canals, including the cochlear nuclei and the auditory cortex. When a deformation is present of the TMJ with tinnitus, the functional MRI shows a hightened activity of the neurons of the cerebellum, the ventrolateral nucleus of the thalamus, the auditory nuclei and the motor part of the cortex. (6). The functional MRI shows three types of neuronal reactions in tinnitus patients:

- Hightened activity of the neurons in the amigdala, resulting in anxiety and irritability (7)
- Hightened distribution of the neuronal activity, which as a result has registered tinnitus
- Hightened activity of the neural response from the auditory part of the cortex, which leads to hyperakusis.

Research, conducted in people aged 55-65 shows 12% of the patiens experience tinnitus, and 2% of them exhibit hinderence in their work capacity and everyday life. (1) Tinnitus can be either objective – with presence of real noise and subjective – fantom presence of noise. Objective tinnitus has a multiple etiology such as occlusion of the porus acusticus externus, dehiscence of the semicircular canal, stenosis or aneurism of carotid artery, glomus tympanicus, contraction of the m.tensor tympani, etc. Subjective tinnitus is caused from dysfunction of the peripheral and central part of the auditory analisator. According to many autors, tinnitus is considered for an auditory fanthom phenomenon. It is caused from a wide variety of etiological factors:

- Loud noise source;
- Neurosensory decrease of hearing- Manier disease, autoimmune diseases of the inner ear, neurosensory deafness, cochleitis;
- Dysfunction of the auditory cortex – brain tumor;
- Retrocochlear neurosensory hearing loss – neurinoma acoustici;
- Depression
- Pharmacological etiology
- Dysfunction of the TMJ

Methods of examination

The anamnesis has to include information whether the beginning was abrupt or progressive; the intensity and duration of the tinnitus; present one-sided, double-sided or in the whole head; fluctuating, pulsing or permanent. The audiological examination includes: tonal audiometry, otoacoustic emissions, high-frequency audiometry. 50%of tinnitus patients over 50 years and 21% of the patients below 50years have lesions on the white matter and neurovascular problems during MRI. A psychophysical examination of the noise is needed by using the visual scale from 0-10 and different questionairs (THI, THQ,TRQ,TQ), which are related to determining the severity of the tinnitus and its effect on the quality of life and work capacity of the patient, as well as symptoms of depres-

sion, irritability and insomnia. The psychoacoustic characteristics of the noise include lateralisation in one-sided tinnitus and combination of different frequencies in double-sided tinnitus; height of the noise in dB; interception of the noise and residual inhibition. Factors, that have an effect on the intensity and volume of the noise, such as contraction of the neck muscles, stress,loud noise, rhinitis, pharyngitis, fatigue, alcohol, salty diets and smoking, should be taken into account. There are two contemporary tests, which determine the noise:

- Transcranial stimulation using a magnetic field. The aim is to suppress the cortical hyperactivity and the accompaning noise. The pulsing magnetic field is selectively placed on the proection of the auditory zone of the cortex. The procedure is used to decrease the intensity of the noise. When the apparatus is placed on the head it is considered that the magnetic field has a working diameter of 3cm and between 2-3cm in depth.
- Electric transtympanic stimulation of the promontorium. The test determines whether the electric stimulation of the promontorium can influence tinnitus. The test uses electrocochleography. Using an electrode from 0-500μA,a noise is induced between 50-1600Hz. The patient answers whether he can hear the sound and whether there is any change in the tinnitus.

Treatment

The treatment of tinnitus is hard, complex and it includes a wide variety of pharmacological, psychosomatic, surgical and physioterapeutic procedures. There is no specific therapy for chronic tinnitus, which can be applied for all patients.

- Medication therapy includes vasodilatators, antispasmolitics, antihistamins, neurotransmiters, Ca-antagonists,local anesthetics, sedatives such as anticonvulsants and antidepressants.
- Surgical treatment – intratympanic application of Gentamycin, corticosteroids and lidocaine.
- Transcranial magnetic and electric stimulation – non-invasive method
- Musical therapy with masking of the noise, diversion of attention.
- Hypnosis, relaxation, stress relief
- Tinnitus masker with auditory prosthesis

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