AGE-RELATED HEARING LOSS, TRADITIONAL COMPILATION

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YAŞA BAĞLI İŞİTME KAYBI, GELENEKSEL DERLEME

ÖZ

Küresel nüfus hem yurt içinde hem de yurt dışında giderek yaşlanmaktadır. Yaşlanma, işitsel sistemde çeşitli anatomik ve fizyolojik değişikliklere yol açar. Bu değişiklikler "yaşa bağlı işitme kaybı" olarak adlandırılan işitme bozukluklarına neden olur. Yaşa bağlı işitme kaybı, yaşam kalitesini etkileyen yaygın bir kronik sağlık sorunudur. Yaşa bağlı işitme kaybını önleyen herhangi bir müdahale mevcut değildir. Ancak günlük yaşam fonksiyonlarını ve iyilik halini iyileştirebilecek, işitme kaybının olumsuz etkilerini azaltabilecek veya telafi edebilecek müdahale seçenekleri mevcuttur. Bu nedenle yaşa bağlı işitme kaybı ile ilgili çalışmaların önemi giderek artmaktadır.

Anahtar kelimeler: Yaşa bağlı işitme kaybı, yaşlı, presbiakuzi

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ABSTRACT

The global population is gradually aging both domestically and abroad. Aging leads to a variety of anatomical and physiological changes occur in the auditory system. These changes cause hearing impairments that are called "age-related hearing loss." Age-related hearing loss is a common chronic health condition that affects quality of life. There is no intervention available that prevents age-related hearing loss. However, there are intervention options that can improve daily life functions and well-being as well as decrease or compensate the negative effects of hearing loss. Thus, the importance of studies about age-related hearing loss has been progressively increasing.

Keywords: Age-related hearing loss, elderly, presbycusis

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INTRODUCTION

Hearing is a complex function involving various mechanisms. These mechanisms and functions are affected by aging (1, 2). As a replacement of the term "presbycusis" which was first used by Zwaardermarker in 1893 and means "hearing loss in the older age" (2) the term "age-related hearing loss" (ARHL) is preferred today (3).

Across the world, the prevalence of age-related hearing loss is predicted to vary between 30% and 40%. This rate increases every year depending on the prolongation of life duration. The ratio of the elderly population to the total population in the world will reach about 22% (1.2 million) by 2050, and more than 500 million elderly individuals will substantially be affected by age-related hearing loss (2, 4). On the other hand, our country is estimated to have 20.8% elderly in 2050 (5).

There are many causes of age-related hearing loss: genetic predisposition, environmental factors, and medical conditions. Many studies have been conducted on genetic predisposition in age-related hearing loss. As a result of these studies, the “Glutamate Metabotropic Receptor 7 (GRM7)” gene in the glutamate metabolism is reported to have an effect on age-related hearing loss. Chronic middle ear infections, hypertension, diabetes, atherosclerosis, hormones (including those that differ according to gender) are medical conditions that increase the risk of hearing loss. Smoking and exposure to noise, chemicals, and ototoxic drugs are among the environmental etiologic factors (1 - 4).

Age-related hearing loss is interpreted differently by researchers. While some researchers define it as a hearing disorder resulting from changes in the cochlea caused by aging, others describe it as a hearing disorder arising from the changes in all the sections of the auditory system (2).

Changes in the inner ear and the central connections of the inner ear due to aging have been shown in detail. In 1974, Schuknet classified age-related hearing losses under four sub-titles according to the histopathological changes in the cochlea, medical history, and audiometric configurations. According to this classification, age-related hearing losses were grouped as "sensory presbycusis", which exhibits abrupt decreases in high frequencies threshold depending on the loss of hair cells and supporting cells; "neural presbycusis", which emerges with the loss of cochlear neurons and causes progressive loss of word discrimination; "strial presbycusis", which includes flat threshold levels as a result of lateral wall and stria vascularis atrophy; and "cochlear conductive presbycusis", which is associated with a gradually sloping high frequency threshold due to the loss of the thickening of the basilar membrane (3).

In 1993, Schuknet and Gacek added two more sub-titles to the classification as "mixed presbycusis", which includes all of the above-mentioned pathologies and "indeterminate presbycusis", which does not include any of the aforementioned pathologies (3, 6). However, contrary to this classification, there are many causes of age-related hearing loss. Age-related hearing loss does not result only from changes in the inner ear but also changes in the middle ear or multiple changes along the nerve pathways (2). Studies on conductive hearing loss in elderly people have attracted less attention than other categories for years. Changes in the sound transmission mechanism of the auditory system is suggested to not play such a significant role in leading to hearing loss. However, recent work has used technology including devices that evaluate the external/middle ear. These findings have identified some changes in the dynamic characteristics of the middle ear due to aging (7-10).

Consequently, both conductive and sensorineural hearing loss and central auditory processing disorder can be observed in age-related hearing loss (11). Thus, it is critical to evaluate the external, middle, and inner ear as well as central auditory processing to enable proper diagnosis and management in elderly people (10, 12).

Evaluation in Age-Related Hearing Losses and Intervention

In age-related hearing loss, evaluation includes medical history, physical examination, and audiological testing. Central auditory processes and cognitive evaluations should be carried out in addition to the basic audiological evaluations in order to reveal the condition of the patients in a more accurate way and to plan the most suitable intervention in line with the information obtained (12).

Medical history is taken following the physical examination including otoscopic examination of the external auditory canal and tympanum. It is recommended that the medical history should be taken quickly in a quiet and comfortable environment to prevent the patient from getting tired and distracted. The duration of the complaint, etiologic risk factors (exposure to noise, ototoxic drug use, family history etc.), and accompanying symptoms (tinnitus, dizziness etc.) should be investigated. Peripheral auditory sensation is then evaluated by audiologic tests. Evaluation of the peripheral auditory system includes basic audiological evaluation methods that can be listed under two titles as subjective tests (pure-tone audiometry, speech audiometry) and objective tests (immittance and otoacoustic emission tests) (2, 12).

Pure-tone audiometry and speech audiometry tests provide very useful information for the determination of the appropriate intervention and the comparison of pre- and post-intervention results. In the pure-tone audiometry, air conduction, and bone conduction hearing thresholds are determined (13).

Audiological evaluation of air conduction and bone conduction hearing is significant in the differential diagnosis of conductive hearing loss and sensorineural hearing losses. Acoustic energy reaches cochlea via two ways: air conduction and bone conduction. Acoustic energy is conducted in both air and bone and stimulates the same region in the cochlea. Air conduction is the pathway where the sounds coming from the surroundings start from the external ear and are conveyed to the oval window. Bone conduction pathways are more complex. Studies have shown that there are different mechanisms related to the bone conduction of the acoustic energy. These mechanisms transmit vibrations resulting from access of the sound vibrations to the skull and the vibration of the skull to the cochlea. These processes stimulate the cochlea (14-16). The most common complaint is inability to understand speech in noisy environments in age-related hearing loss. Thus, speech recognition should be measured in a noisy background for the elderly (2, 12).

In the case of age-related hearing loss, pure tone audiometry test findings may vary. However, there is frequently a decline in high-frequency (over 2kHz) hearing thresholds in the sixth decade. While high-frequency hearing thresholds continue to drop, hearing thresholds in the mid and low frequencies (0.5–2 kHz) also progressively involve (17). Although there is a difference of less than 15 dB between air and bone conduction thresholds in age-related hearing loss, there is a significant air-bone gap with age at high frequencies (>3 kHz) in investigations (18, 19). In the histological study conducted by Dobrev et al., it was reported that this difference occurs due to the widening of the incudomalleolar joint space with increasing age (19). Speech discrimination scores in age-related hearing loss with steeply sloping audiograms do not surpass 70–80% (2). The more severe the hearing loss, the more difficult it may be to understanding speech. However, in the case of age-related hearing loss, speech audiometry test results obtained in a quiet listening environment are not a good predictor of speech comprehension issues encountered in real-life conditions. As a result, words or sentences recognition tests in noise are becoming more popular in speech audiometry (20).

Two subtests are commonly used clinically for immitansmetric measurements: Tympanometry tests evaluate the external and middle ear, and acoustic reflex tests evaluate the stapedial reflex pathway (21). Tympanometry is an objective test measuring the acoustic immittance of the middle ear with changes in the ear canal air pressure. (22).

In clinics, 226 Hz probe tone (traditional) immitansmetric measures are routinely used. There are considerable discrepancies in some evaluation parameters among studies analyzing traditional tympanometric test findings in aged adults in the literature. When these studies are examined, it is reported that the ear canal volume is larger, the tympanometric peak pressure is more negative value, and the tympanometric width values are lower in elderly individuals (9, 23-27).

Otoacoustic emission (OAE) tests are objective tests that evaluate sounds produced by the outer hair cells in the cochlea and recorded from the external auditory canal. Clinically, the purpose of OAE tests is to evaluate the functions of the outer hair cells. These tests also give information about the transfer function of the middle ear. There are two main sub-tests differing by giving stimulus (evoked OAE test) and by not giving stimulus (spontaneous OAE test). Evoked OAE tests are classified according to the type of the stimulus used as transient evoked OAE, distortion-product OAE, and stimulus-frequency OAE. The distortion-product OAE (DPOAE) test has advantages such as obtaining a response in sensorineural hearing loss up to 50 dB and gives specific information on the frequency. In the DPOAE test, the measurement method (fixed-ratio method) is widely used. Here, records are taken by keeping the stimulus intensity fixed and changing the frequency (28).

It is known that the amplitude of OAEs decreases with the increase in hearing thresholds. However, regardless of hearing loss, the amplitude of the OAEs decreases with aging (29, 30, 31). Hoth et al. found a decrease in the amplitude of TEOAE and DPOAE at high frequencies in older people with normal and near-normal hearing thresholds (1–4 kHz), which was attributed to age-related hearing loss (31). Early detection of hearing loss is critical for improving quality of life by preventing the development of more serious problems and providing more structured rehabilitation. From this point of view, especially high-frequency DPOAE measurements are important in the early diagnosis of age-related hearing loss (32).

Auditory processing disorders are common in elderly subjects. Moreover, the elderly often complain of hearing impairment although hearing thresholds are within normal limits. This results from the difficulty in understanding the speech caused by the central auditory pathway dysfunction. The tests performed to evaluate the functioning of the central auditory pathway can be classified as objective and subjective tests. Auditory evoked potentials are objective tests that evaluate the pathways from the inner ear to the cortex. Auditory evoked potential tests are called according to the place of their production and time. These are cochlear potentials (electrocochleography- EcochG), auditory brain stem responses (ABR), auditory middle latency response (AMLR), auditory late latency response (ALLR), cognitive potentials (P300), and mismatch negativity (MMN). Subjective tests are divided into two as verbal (monaural speech tests, dichotic speech tests, and binaural integration speech tests) and non-verbal tests (random gap detection test, frequency pattern test, and duration pattern test, which evaluate temporal processing) (2). Clinically, the ABR is a widely used objective audiological test. The ABR consists of seven positive waves in the 1-7 ms after the auditory stimulus. The first five waves are used in clinical evaluations: wave 1 from distal portion of the auditory nerve brainstem, wave 2 from proximal portion of the auditory nerve brainstem, wave 3 from the cochlear nuclei, wave 4 from superior olivary complex, and wave 5 from lateral lemniscus (33).

It has been shown that age-related central auditory processing dysfunction makes it more difficult to understand words in noise and that speech perception in noise decreases after 50 years old. Similarly, aging causes declines in dichotic sentence recognition tests and temporal processing tests. Electrophysiological measures are commonly used to assess age-related central impairments. In the age-related hearing loss, the ABR test shows a drop in thresholds and a prolonging of latency in the P300 test (34).

Mental disorders, depression, social isolation, and anxiety are common in patients with age-related hearing loss. It is important to evaluate these problems using questionnaires and scales adapted for the elderly. This can help with the rehabilitation of patients with age-related hearing loss. The Beck Depression Inventory can be utilized in evaluations because it is reported that 42% of persons with age-related hearing loss require psychological help. Another important test that can be used to examine patients’ mental disorders with age-related hearing loss is the Hearing Impairment Inventory for the Elderly (12).

There is no intervention available that prevents age-related hearing loss. However, there are intervention options that can improve daily life functions and well-being as well as decrease or compensate the negative effects of hearing loss. Hearing aid given according to the type and level of the hearing loss of the patient is the first and most effective intervention method. However, a small percentage of elderly subjects benefit from a hearing aid. A cochlear implant is another intervention option in cases when no benefit can be obtained from hearing aids due to an increase in the severity of the hearing loss. When communication abilities decrease due to hearing loss, interventions such as auditory rehabilitation (including interventions such as active listening training, speech reading, and communication enhancement) should also be used (4).

CONCLUSIONS

Hearing loss is a significant element that harms the elderly's mental health, social life, and speech perception. Although it is difficult to prevent age-related hearing loss due to its degenerative nature, some precautions (such as noise and ototoxic medication avoidance) and more effective rehabilitation with early diagnosis may be achievable. As a result, understanding age-related hearing loss is critical. This review discusses the causes, nature, evaluation techniques, and rehabilitation of age-related hearing loss. There is a need for research on appropriate screening and intervention programs for the elderly to improve their hearing.

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