Effects of Ageing on Otoacoustic Emission

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Abstract To study the effects of ageing on otoacoustic emission (OAE) in individuals with normal pure tone audiogram (PTA). Tertiary/Medical College Hospital. Descriptive/Prospective study. We screened healthy individuals: (1) 50 persons in the age group of 20–25 years. (2) Fifty persons in the age group of 45–50 years. (3) Fifty persons in the age group of 55–60 years. (1) The individuals in the age group of 20–25 years showed absent/decreased distortion product OAE (DPOAE) in two cases (2/50) with normal PTA. (2) The individuals in the age group of 45–50 years showed absent/decreased DPOAE in eleven cases (11/50) with normal PTA. (3) The individuals in the age group of 55–60 years showed absent/decreased DPOAE in 47 cases (47/50) with normal PTA. Just like any other organ in the body which exhibits the process of ageing, the cochlea too undergoes similar changes to the ageing process. The DPOAE is the first sign to disappear in presbycusis. The many factors which hasten the onset of presbycusis-like nutrition, lifestyle, environment and occupational hazards, infection and illness, drug intake, hereditary etc.; can be modified for prolonging a healthy natural hearing.

Keywords Ageing · Pure tone audiogram · Distortion product otoacoustic emission · Presbycusis

Introduction

Ageing is a natural process which a living thing undergoes in its life time. The agility and reflexes which are present in the youth and adult life is not present in the old age. Due to ageing, one experiences various diseases and degenerative conditions. A person who was healthy in his/her youth and adulthood, loses his ‘health’ in his old age.

Joint pains due to osteoarthritis; decreased vision due to presbyopia; metabolic disorders like diabetes mellitus; decreased hearing due to presbycusis; loss of bone density due to osteoporosis; loss of muscle mass due to decreased physical activity; loss of appetite, loss of memory or even loss of concentration is attributed to the ageing process.

Though there are many theories to explain the physiology of ageing and the changes the body and the various systems undergo due to the ageing process, but there is not one which gives a convincing answer to the question ‘why we grow old?’.

Otoacoustic emission (OAE) is a sensitive indicator in understanding the functions of the cochlea. The OAE is absent in various diseases like diabetes mellitus, hypothyroidism, chronic kidney disease etc. OAE is absent even before the onset of hearing loss on pure tone audiogram (PTA).

In this study, we try to analyze the effects of ageing on the cochlea based on this point.

Hypothesis

To study the effects of ageing on OAE in individuals with a normal PTA.

As the OAE is a sensitive indicator for the functions of the cochlea, any absence of OAE is an early sign of hearing

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loss either due ageing or otherwise. Preventive steps can be taken from a progressive hearing loss to less gradual hearing loss or in other words preservation of natural hearing as far as possible. Anytime disability prevention is always better than disability rehabilitation.

Material and Methods

Inclusion Criteria

Fifty healthy individuals in the age groups of 20–25, 45–50 and 55–60 years with a normal PTA were studied.

Exclusion Criteria

Individuals not satisfying the age criteria, with ear diseases/disorders, chronic systemic illness, abnormal PTA, prolonged drug intake, unhealthy habits like alcohol consumption and smoking etc.

Procedure

Healthy persons in the age group of 20–25 years were chosen. They were subjected to routine systemic and ENT examination. Once they were found to have no abnormality they underwent PTA. When the PTA was normal, distortion product OAE (DPOAE) was done. The data so obtained was tabulated and analyzed.

The procedure was repeated to the individuals in the age group of 45–50 and 55–60 years.

Results

- (1) Fifty individuals in the age group of 20–25 years who had no systemic and ENT disorders and a normal PTA, DPOAE was absent in two cases.
- (2) Fifty individuals in the age group of 40–45 years who had no systemic and ENT disorders and a normal PTA, DPOAE was absent in eleven cases.
- (3) Fifty individuals in the age group of 55–60 years who had no systemic and ENT disorders and a normal PTA, DPOAE was absent in 47 cases.

Discussion

Ageing is a continuous process in the life of a living being. It is one of the constant thing, a living being undergoes.

There are many theories which explain the physiology of ageing. To name a few:

- (1) Evolutionary theory
- (2) Molecular theory
- (3) Cellular theory
- (4) System based theories of ageing: neuroendocrine and immune theories [1].

The body undergoes various changes as one grows old, whether it is cardiovascular, pulmonary, skeletal, renal, metabolic and fluid and electrolyte homeostasis.

Just like any other system mentioned above, the sense organs of hearing [2], vision, taste and proprioception too undergoes changes.

We undertook a study to know the effects of ageing on OAE in individuals with normal hearing. It is known fact that, as one grows old the hearing faculty decreases. Presbycusis is observed in elderly persons [3]. The onset of presbycusis is not consistent among individuals. There are many factors which hasten the onset of presbycusis-like nutrition, lifestyle, environment [4] and occupational hazards, infection and illness, drug intake, hereditary etc.

Before the onset of presbycusis and its observance on PTA, the DPOAE shows subtle changes. The DPOAE starts to decrease as one grows old.

It has been noted that hearing changes do not occur only in peripheral auditory system [5]. A loss of hearing of pure tone, particularly in higher frequencies is recorded and it is found to be more pronounced in man. And this can interfere with both hearing and understanding speech. Brain-stem changes may lead to difficulty hearing and localizing sounds in noisy environments. Cortical changes may lead to problems with difficult speech and language. Thus, the changes in hearing function are more complex than just pure tone loss. So, preservation of natural hearing attains significance than just rehabilitation of age related hearing loss.

With changes in environment, mean life span has increased, due to which we come across a whole lot of age related problems in the society. Understanding the effects of ageing [6–10] on the physiologic functions of the body is the secret to lead a healthy life of the elderly.

Once the presbycusis is established, it is irreversible because the specialized neural cells of the auditory and vestibular systems are non-mitotic and thus cannot undergo replication and renewal. Depending on the pathophysiology presbycusis is grouped as sensory, neural, metabolic or strial and conductive.

- (a) In sensory presbycusis there is loss of both hair cells and supporting sustentacular cells isolated to the basal turn of cochlea.

- (b) In neural presbycusis there is loss of cochlear neurons involving the whole of cochlea.
- (c) In stria presbycusis there is a patchy atrophy of the stria vascularis in the middle and apical turn of the cochlea, without the loss of cochlear neurons.
- (d) In conductive presbycusis the basilar membrane has been suggested as causative of the gradually slopping high frequency hearing loss.

Thus DPOAE is a sensitive indicator to predict the onset of hearing loss related to ageing.

Conclusion

DPOAE is a very good pointer for the onset of cochlear hearing loss in elderly patients in healthy or otherwise.

The many factors which hasten the onset of presbycusis-like nutrition, lifestyle, environment [4] and occupational hazards, infection and illness, drug intake, hereditary etc.; can be modified for prolonging a healthy natural hearing.

Key Message: By this study we understand the process of the ageing of the cochlea takes place beyond 50 years in a normal healthy people. With proper modification of diet, lifestyle and other risk factors, the effects of ageing on the cochlea can be delayed still further. DPOAE is a good indicator of predicting the gradual loss of natural hearing in the healthy.

Patients with other systemic disorders also can be screened for hearing loss based on the presence or absence of DPOAE even before the hearing impairment is manifested on PTA.

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