

Influence of coexisting internal diseases on hearing loss in patients over 50 years of age

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A – Study Design, **B** – Data Collection, **C** – Statistical Analysis, **D** – Data Interpretation, **E** – Manuscript Preparation, **F** – Literature Search, **G** – Funds Collection

Summary Background. Presbycusis is a physiological hearing defect progressing with age, caused by degenerative changes in the inner ear. Chronic internal diseases can change the development of age-related hearing loss.

Objectives. The aim of the study was to determine the influence of chronic internal diseases (hypertension, diabetes, hyperlipidaemia) on the process of hearing loss in people over 50 years of age.

Material and methods. 215 audiological patients with hearing loss and internal disease were compared with 80 patients with physiological hearing loss (presbycusis). We analysed the results of hearing thresholds in the pure tone audiometry. The results were analysed in four age groups: 50–59, 60–69, 70–79 and 80+.

Results. The relation between internal chronic diseases, different age groups and HL for mean values of 1 kHz, 2 kHz, 4 kHz and 8 kHz frequencies showed that the greatest progression of hearing loss was caused by hypertension and diabetes. The most significant differences were found in the 50 to 59 age groups. Additional significant differences were observed in the 60–69 age range for hyperlipidaemia patients, but the significance level was smaller.

Conclusions. Each of the chronic internal diseases is distinguished by a progression of hearing loss in patients' lives after 50 years of age. Diseases such as hypertension or diabetes or hyperlipidaemia cause a considerably faster progression of hearing loss in the earlier period of life of elderly patients.

Key words: hearing loss, disease, patients.

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Background

With an aging population, hearing loss (HL) in patients over 50 years of age is becoming an increasing clinical and social problem. One-third of people over 65 years of age suffer from disabling HL. The prevalence of HL is estimated at 30–40% in the population aged 65 to 74 years and at 50–80% in the population aged 75 years and older depending on the criteria for HL and the recruiting procedures used in the study [1]. The elderly population is rapidly growing, and more and more elderly people are visiting family practitioners.

Presbycusis is defined as a physiological HL progressing with age, caused by degenerative changes in the inner ear and the central nervous system [2]. The processes are of an atrophic-degenerative type and involve the Corti organ, spiral ganglion, stria vascularis and the nuclei of the auditory nerve. Presbycusis is characterised by HL at high frequencies, as well as a reduced understanding of speech [3]. It is a part of geriatric syndrome (GE). GEs have been viewed as conditions in which symptoms are assumed to result not solely from discrete diseases, but also from accumulated impairments in multiple systems

[4]. GE includes hearing loss, dementia, dizziness, gait disorders, urinary incontinence, osteoporosis and loss of vision [5].

HL can mimic a weakening of cognitive processes. Moreover, HL is known to exaggerate the effects of cognitive deficits and has been found to predict a more rapid cognitive decline. The prevalence of dementia, as well as hearing impairment, is increasing with age.

Auditory function can also be impaired by internal diseases, such as diabetes, hyperlipidaemia and hypertension. A combination of diabetes and sensorineural HL has been reported by Janssen et al. [6, 7]. Kakarlapudi et al. [8] noted that HL was more common in diabetic patients than in their age-matched controls. HL was significantly greater in diabetic subjects up to 60 years of age than healthy age-matched controls [9]. It is also suggested that diabetes may act synergistically with the processes involved in the development of age-related HL [7, 9]. The effect of hyperlipidaemia has been reported [10, 11]. Arterial hypertension can alternatively influence presbycusis by the agency of atherosclerosis processes and/or an increase in the intima media thickness, which can disturb the microcirculation within the inner and middle ear [12].



Objectives

The purpose of the study was to assess the hearing level and severity of presbycusis in patients over 50 years of age depending on coexisting internal diseases.

Material and methods

215 audiological outpatients (430 ears, 95 females, 87 males) over 50 years of age with HL and one of the specific chronic internal diseases (groups A–C) or with presbycusis only (group D) were included in the study. The right ear and the left ear in each patient were examined separately. Table 1 presents the number of results (ears) analysed in the various disease groups with regard to the patients' age.

Table 1. Number of ears of patients with internal additional disorders, such as hypertension, diabetes mellitus type 2, hyperlipidaemia (A, B, C), and without diseases – control group (D)

Age	Hypertension (A)	Diabetes (B)	Hyperlipidaemia (C)	Control group (D)
50–59	39	19	28	27
60–69	48	25	20	24
70–79	86	25	20	20
80+	15	23	2	9
Total	188	92	70	80

The chronic internal diseases selected for the study were: (A) hypertension, (B) hyperlipidaemia, (C) diabetes mellitus type 2. The diagnosis was established by a general practitioner or internist. All patients delivered a medical certificate about their chronic internal disease and confirmed that they were not treated for any of the other two analysed diseases. The patients were qualified for groups if the illness had been treated for at least 2 years. Exclusion criteria included: deafness, neurodegenerative diseases, dementia, conditions that change the result of hearing tests, ontological operations and acute infections of the ears, nose and throat, as well as uncontrolled treatment of the previously mentioned internal diseases. The control group consisted of 80 patients with presbycusis, but with no systemic or laryngological diseases (D). Group D served as the reference group in the statistical analyses. Within each group, the patients were next divided into four age subgroups: those 50–59 years of age, 60–69, 70–79 and 80+. This division was made in order to determine in which age group presbycusis was most influenced by the given disease (out of the four chosen for the study). All patients were examined by a neurologist to establish their neurological and mental status. Some audiological examinations were carried out. The main one was pure tone audiometry (PTA) as a simple, non-invasive test. Normal HL in PTA is 0–20 dB HL. In the study, data analysis included only quantitative research in PTA.

Hearing loss for frequencies of 250 Hz and 500 Hz is mainly connected with conduction impairments, while defects in hearing for frequencies of 1 kHz and more tend to deal with perceptive (sensoneural) impairments. This means HL for frequencies of 1 kHz and more tend to concern presbycusis. Thus, the subsequent analyses dealt with the frequencies of 1, 2, 4 and 8 kHz.

Statistical analysis was performed with the Statistica 10 (StatSoft Polska), using non-parametric Anova-Manova and U Mann–Whitney tests, as well as MS Office Excel 2010 spreadsheets.

Results

The results of all patients with internal diseases were compared to the reference group of patients without any chronic internal diseases (group D). This analysis, being the general ratio for evaluating the differences with the level of significance set at $p < 0.05$, suggested that the differences may occur in PTA. The analyses of hearing level were performed separately in relation to the diseases in groups A–D. The mean hearing loss (for a frequency of 1 to 8 kHz) with regard to the patients' age in every age group was compared to the hearing loss in compatible patients from the control group D. Table 2 presents the mean values for the hearing defects in the chosen frequencies with and without age correction for all age groups. A correction with regard to age was made with the use of correction charts [2]. Next, the relation between internal chronic diseases, different age groups and HL was analysed for mean values of the frequencies 1 kHz, 2 kHz, 4 kHz and 8 kHz (Figure 1).

Statistical analyses were carried out for the decades of life studied, namely 1–8 kHz – Figure 1 presents the results.

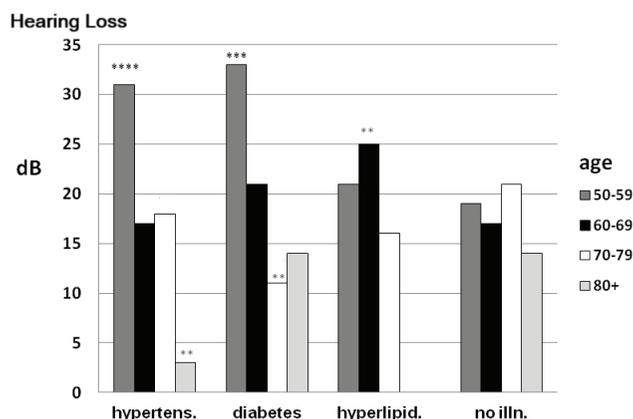


Figure 1. Age-corrected mean hearing loss in the given age and disease groups

The values for patients with internal diseases were compared with the values for the control group. Statistically significant differences can be seen in the results from the Mann–Whitney test (**** – $p < 0.0001$; *** – $p < 0.001$, ** – $p < 0.01$).

Table 2. Mean values of hearing levels in decibels [dB] in pure tone audiometry studies in the examined groups, both with and without age correction [2] and without division into age groups for different frequency in hertz [Hz]

Disease	Pure tone audiometry	Hearing loss in dB					
		250 Hz	500 Hz	1,000 Hz	2,000 Hz	4,000 Hz	8,000 Hz
Hypertension (A)	no correction	20	26	31	41	55	62
	correction	8	13	18	20	22	18
Diabetes (B)	no correction	25	32	35	44	61	61
	correction	13	18	20	20	23	11
Hyperlipidaemia (C)	no correction	24	29	32	37	55	49
	correction	16	20	22	22	28	13
No systemic illnesses (control group) (D)	no correction	29	33	35	40	53	63
	correction	18	22	20	20	22	19

These results suggest that statistically significant HL in patients 50–59 years of age occurs in patients with hypertension (A) ($p < 0.0001$) and diabetes mellitus type 2 (B) ($p < 0.001$). Additional significant differences were observed in the 60–69 age range for group C (hyperlipidaemia patients), but the significance level was smaller ($p < 0.01$).

The study showed that HL in patients suffering from chronic internal diseases is less progressive with age, especially after 70, when compared to hearing loss in patients without other illnesses. Thus, it appears that HL or presbycusis may be stimulated and accelerated, especially by diabetes mellitus type 2 and hypertension, mostly in the 6th decade of life. Later, in the 8th–9th decade, the effect of severe deterioration of HL did not appear.

Discussion

People with presbycusis suffer from sensorineural HL. Besides having problems with the auditory system, patients at the age of 50+ often suffer from other diseases. It is always important to ask about any ear surgeries in the past, as well as ear diseases (e.g. otosclerosis), to exclude conductive HL [13].

The study shows that the increase in sensorineural HL in groups with internal diseases (A–C) is different than in the healthy group (D) and depends on age.

In the treatment of hypertension, besides the tension itself and its hypertrophic changes, the application of hypotensive drugs may also play a crucial role. Their effect can be both negative (ototoxicity) and positive (long-term effects of blood pressure reduction). In the current study, the progress of HL in the hypertension group appeared greatest in the 50–59 age group, while the least progress of hearing loss was observed in the group of patients aged 80+. This problem was observed for all the recorded frequencies, ranging from 1 kHz to 8 kHz. In diabetic patients, the greatest progression of HL occurred in patients 50–59 years of age, too. According to other researchers, hearing loss often occurs in patients with diabetes mellitus type 2 [12, 14, 15]. This observation is also confirmed by our findings. Greater HL for higher frequencies was observed in the 6th and 7th decades of life. However, in the 8th and 9th decades of life, a progression of HL was observed for all frequencies [9, 15]. The 5-year prospective study of Evans et al. proved that a hearing defect for higher frequencies was most prevalent in patients with dyslipidaemia up to 60 years of age [10]. In turn, in patients over 60 years of age, HL was less prevalent. Similar results were observed in our study. It should be emphasised that in most of the cited works, their authors undoubtedly confirm the influence of internal diseases on the progression of hearing loss in the elderly. However, they do not analyse the progression in subsequent time intervals. The fluctuating process of deepening HL in various systemic diseases can be used to monitor and predict the effects of systemic diseases on the hearing organ. Each of the systemic diseases leads to hearing deterioration, but the most severe HL is observed in people over 50 years of age (groups A, B) and 60 years of age (C). The control of biochemical parameters of cardiometabolic risk could be considered in

adolescent and adults as a prevention activities implemented by family doctors among to prevent rapid HL in elderly [16, 17].

HL has been proposed as a modifiable risk factor for dementia, similar to hypertension, diabetes mellitus and dyslipidaemia [18]. Dementia has become the greatest global challenge for health and social care [19], but large groups of patients still have undiagnosed cognitive impairment [20]. This is a clinical syndrome that includes the decline of cognitive and conscious states and is caused by many neurodegenerative diseases, of which Alzheimer's disease (AD) – a progressive, unremitting and neurodegenerative disorder, and vascular dementia (VD) – mainly caused by hypertension and arteriosclerosis, are the most common (AD vs VD: 50–70% vs 20%) [1]. HL is known to exaggerate the effects of cognitive deficits and has been found to predict a more rapid cognitive decline. The prevalence of dementia, as well as hearing impairment, increases with age. As a consequence, older people are often affected by both conditions. Moreover, hypertension, diabetes and hyperlipidaemia lead to vascular problems and can also take part in vascular dementia.

Limitations of the study

There are some limitations of the study. First of all, waist circumference, body weight or body mass index (BMI) were not analysed in the study. It is known that associations exist between obesity and HL [21], and the relationship between metabolic syndrome in children and adolescents and cardiovascular diseases, diabetes and atherosclerosis has been confirmed in clinical studies. Moreover, it could be interesting to evaluate the prevalence of HL in patients with metabolic syndrome not only with hypertension. Secondly, cigarette smoking may affect hearing sensitivity through its effects on the vasculature supplying the auditory system [22]. However, smoking habits were not analysed. Another limitation was the time course of internal diseases. The correlation between severity of HL and time course of coexisting diseases could show some interesting data, too.

Detecting HL and reducing any disability caused by hearing impairment in elderly patients could decrease their cognitive problems and improve the quality of life. It could be important for general practitioners to remember that HL can be an underdiagnosed problem in patients with internal diseases, especially in those over 50 years of age.

Conclusions

1. Each of the evaluated chronic internal diseases leads to a progression of HL and accelerates the process called presbycusis.
2. The deterioration of hearing level in people with chronic internal diseases such as hypertension or diabetes mellitus type 2 or hyperlipidaemia is evident in subsequent decades of patients' lives. The diseases cause considerably faster progression of HL in the earlier period of life than in later one – the greatest after 50 year, most prevalent in patients aged up to 60.

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Conflicts of interest: The authors declare no conflicts of interest.

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