

Effects of Hypertension on Hearing

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Received: 5 November 2012 / Accepted: 9 February 2013 / Published online: 17 February 2013
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Abstract To determine the likely association between hypertension and hearing loss. 150 cases and 124 controls, both genders, aged 45–64, included in the research after sample estimation. Hypertension was verified through blood pressure readings and was classified as grade 1, grade 2 and grade 3 hypertension or no hypertension according to the blood pressure readings. Hearing was assessed by measuring pure tone threshold at various frequencies ranging between 250 and 8,000 Hz. There is a significant association between hypertension and increase in the hearing threshold. Hearing loss in the population under study suggests that hypertension is an accelerating factor of degeneration of the hearing apparatus due to aging. Association between Increased hearing threshold and hypertension in this research, can allow for an integrated work of cardiologists, nephrologists, otorhinolaryngologists, audiologists and other health professionals concerned with alterations caused by hypertension.

Keywords Hearing loss · Hypertension · Hearing threshold

Introduction

The hearing loss (HL) is a factor that irrespectively of the degree of commitment affects the quality of life and when

acquired in adults, it appears gradually and may make the oral language receiving difficult.

In the adult population, studies confirmed that hearing loss starts at about 30 years old, and increases progressively along the years, although there is a resemblance in the audiologic configuration, men are affected earlier and more intensely than women. The hearing system affection may cause psychosocial effects, like low self-esteem, isolation, depression and irritability, which can interfere with the quality of life of the individuals. Moreover, it is known that metabolic changes, such as systemic arterial hypertension (SAH) is present in adults and may be empowered by the presence of hearing loss or vice versa.

According to data from the ASHA (American Speech-Language–Hearing Association) [1], there are currently 28 million individuals in the USA with some type of hearing loss, and 80 % of those are irreversible cases. These data also show that 4.6 % of the individuals between 18 and 44 years have hearing loss, while 14 % of middle aged individuals—between 45 and 64 years, and 54 % of the population above 65 years have some hearing loss. This is due to a number of factors, such as intense and/or continuous noise exposure, inhalation of toxic substances, ingestion of ototoxic drugs, metabolic and circulatory alterations, infections, different types of injuries and genetic inheritance.

The relevance of Arterial Hypertension as a human disease is due to its clinical complications, morbidity and mortality, as well as the heavy burden to the patient, family and public. Few diseases are responsible for so frequent and severe complications as the ones accruing from Arterial Hypertension: stroke, heart, kidney and peripheral vascular insufficiencies. Moreover, it is estimated that about half of the deaths of patients above 50 years are due to cardiovascular diseases, and 80 % of them have high blood pressure [2].

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Katz [3] says that all living cells in the human body depend on a proper supply of oxygen and nutrients in order to maintain their function, and such supply depend on the functional and structural integrity of the heart and blood vessels. Hypertension, the most common vascular disorder, may facilitate structural changes in the heart and blood vessels. High pressure in the vascular system may cause inner ear hemorrhage, which is supplied by the anterior inferior cerebellar artery, which supports the inner ear artery and is divided into cochlear artery and anterior vestibular artery [4], which may cause progressive or sudden hearing loss [3, 5]. This circulatory system pathology may directly affect hearing in a number of ways. One of the vascular physiopathological mechanisms described is the increase in blood viscosity, which reduce capillary blood flow and ends up reducing oxygen transport, causing tissue hypoxia, thus causing hearing complaints and hearing loss in patients [6]. Moreover, arterial hypertension may cause ionic changes in cell potentials, thus causing hearing loss [7].

The results attained with the present research project will certainly serve as basis for a greater integration between cardiologists, nephrologists, otorhinolaryngologists, speech therapists and other health care professionals involved with arterial hypertension and hearing loss care, bringing about relevant data for the professionals involved in order to improve quality of care in the therapy and rehabilitation of these patients.

Methods

Subjects

This research was carried out through a case controlled study, after the project was analyzed and approved, and an informed consent was signed.

Hypertensive Subjects

375 patients with diagnosed hypertension were selected randomly, who were receiving care at our tertiary care hospital for any reason between the age group of 45 and 64 years. The patients outside this age group were excluded from the study leaving 246 patients. Those patients who were wearing hearing aids and those who were undergoing treatment for any neurologic disorders, were also excluded from our study. Subjects with air-borne gap of more than 10 db were also excluded from our study.

We also excluded patients with previous history of specific hearing disorders (such as rubella and head injuries), specific metabolic disorders (such as diabetes) and specific vascular disorders (such as strokes), and also individuals who worked or had worked in an environment

that could cause noise-induced hearing loss, patients with kidney diseases and with prior history of hospital stay or ingestion of potentially ototoxic medication or drugs were also taken off the study.

This leaves about 164 patients with diagnosed hypertension to be included in our study of which 14 patients did not come for follow up leaving only 150 hypertensive patients to be eligible for the study.

Comparison Subjects

We randomly selected 300 patient without hypertension who were receiving care at our hospital. The patients outside the age group of 45–64 years were excluded from the control group. Same exclusion and screening criteria were applied to these patients as for the hypertensive patients leaving 182 patients to be included in the study, of which 58 subjects did not come for follow up. This leaves 124 patients without hypertension to be included in our study.

Data Collection

All Subjects were given questionnaire which included questions regarding the duration of hypertension, treatment history, and the associated complications such as tingling, numbness or burning sensations in hand and feet.

The major variable of exposure in our study was Arterial Hypertension, and the outcome variable was hearing loss.

Blood pressure was measured indirectly with a proper cuff and mercury gauge manometer.

Patients with arterial blood pressure $\geq 140/90$ mm of Hg in different measures, were considered positive for high blood pressure.

History Taking It was carried out as a closed set and contained information about the auditory and vestibular disorders symptomatology, presence of tinnitus, as well as exposure to hearing harmful agents, such as occupational or leisure noise, ototoxic drugs and general health conditions.

In order to assess blood pressure we used a tool for systematized clinical data filling out and some questions:

Identification data: name, age, gender, weight, height, arterial pressure.

Questions:

1. Do you have high blood pressure?
() yes () no
2. Have you had your blood pressure measured recently?
() yes () no

3. When was the last time you measured your blood pressure?
4. What has been your blood pressure recently?

SP/DP

5. Do you usually take medication to control your blood pressure?

() yes () no

6. Which medication (s) do you take?

Acoustic immittance measurements: carried out in order to evaluate the tympano-ossicular system, by means of tympanometric curve and acoustic reflexes research.

Conventional Tonal Audiometry Researched frequencies belonging to the range from 0.25 to 8 kHz, for the airways and 500 to 4 kHz for the osseous way, when the airways were equal or below 20 db. For the tonal thresholds researches we used the pure tone.

Data Management

Data collected from the questionnaire was analysed. Study participants were classified into different grades of hypertension according to the blood pressure readings as per the WHO criteria for hypertension.

Hypertension is generally diagnosed on the basis of a persistently high blood pressure. Usually this requires three separate sphygmomanometer measurements at least one week apart. The WHO/ISH blood pressure classification includes 3 grades of hypertension as shown in Table 1.

Data was analyzed using SPSS software and the *p* value was calculated using pearson's correlation method.

Results

A total of 284 subjects were include in our study of which 124 were control subjects (without hypertension) and 150 were diagnosed with hypertension of which 68 patients were diagnosed with grade 1 hypertension according to WHO classification for hypertension, 47 patients were diagnosed with grade 2 hypertension and 35 patients were diagnosed with grade 3 hypertension.

Table 1 Grading of hypertension

Blood pressure (mm Hg)	Grade 1	Grade 2	Grade 3
SBP	140–159	160–179	≥180
DBP	90–99	100–109	≥110

DBP diastolic blood pressure, SBP systolic blood pressure

Table 2 shows the characteristics of the study participants. Male participants predominated in our study with an average of 65.8 %.

Mean duration of hypertension was greater in grade 3 hypertension with a mean duration of 9 years as compared to mean duration of 3.7 years in grade 1 hypertension and 5.4 years in grade 2 hypertension.

Table 3 provides the pure tone threshold results of both ears measured at various frequencies ranging between 250 and 8,000 Hz according to the grades of hypertension.

The increase in hearing threshold was greater in grade 3 hypertension with the threshold increasing at higher frequencies though it was no more than a mild hearing loss.

The *p* value calculated by Pearson's correlation method was found to be less than 0.001 showing a significant association between hypertension and increase in hearing thresholds.

In the present study, there was a mild hearing loss in 18 % of patients without hypertension. 36.7 % of patients with grade 1 hypertension included in our study suffered from mild hearing loss, 40.4 % of patients with grade 2 hypertension and 54.2 % of patients with grade 3 hypertension were found to be suffering from mild hearing loss.

Discussion

The present study showed the existence of an association between hearing loss and arterial hypertension in individuals aged between 45 and 64 years, and. Such association between hearing loss and arterial hypertension has been an important object of research in recent decades, with highly antagonistic conclusions, and some authors back this association [8, 9], while others deny it and even present different results in studies carried out at distinct times [8–11].

As to the methodological characteristics of this study, the care is taken in outlining the age factor, focusing on the age range of middle aged individuals, between 45 and 64 years as they do in hypertension investigations [12, 13], the strict exclusion criteria, eliminating individuals with diseases and specific activities capable of producing hearing alterations and the care taken in diagnosing their hearing loss and arterial hypertension certainly helped to reduce selection biases.

With aging, there is a higher number of chronic diseases. SAH and hearing loss have important prevalence in the elderly population [14]. In this study we observed that although the sample individuals were between 45 and 64 years (middle aged), the higher age range proved to be an independent risk factor for hearing loss. This is probably due to the fact that, with age there are structural alterations in the whole body, including the hearing system [1].

Some studies justify that the sensorineural hearing loss that happens with aging is related to a microcirculatory

Table 2 Characteristics of study participants

	No HT		Grade 1 HT		Grade 2 HT		Grade 3 HT	
	No.	%	No.	%	No.	%	No.	%
No. of patients	124	100	68	100	47	100	35	100
Gender								
Male	78	62.9	45	66.1	31	65.9	24	68.5
Female	46	37.09	23	33.8	16	34	11	31.4
Mean blood pressure	94.6		111.5		120.9		133.7	
Mean duration Of HT	NA		3.73		5.46		9.05	

HT hypertension

Table 3 Mean pure tone thresholds by hypertension severity

PTH (Hz)	No HT		Grade 1 HT		Grade 2 HT		Grade 3 HT	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Right ear								
250	8.43	6.12	11.85	5.8	18.68	6.8	19.11	6.6
500	9.44	6.81	13.89	7.1	19.65	8.6	21.02	7.3
1,000	10.11	7.07	15.94	8.8	20.93	9.5	22.2	7.7
2,000	11.09	7.92	17.64	9.1	22.31	10.6	24.68	9.2
4,000	12.11	8.42	18.83	10.2	23.51	10.8	25.22	10.1
8,000	13.12	9.47	21.27	13.1	25.89	13.7	27.62	12.5
Left ear								
250	8.73	6.56	11.32	5.1	19.17	7.2	19.85	7.3
500	10.12	7.2	13.61	6.8	20.19	9.3	22.28	7.9
1,000	11.13	7.86	16.41	9.1	21.55	9.7	22.97	8.2
2,000	12.17	8.41	18.14	9.6	23.27	10.8	25.48	10.2
4,000	13.15	8.78	19.13	10.7	24.29	11.1	26.37	10.8
8,000	14.12	10.5	22.2	14.1	27.36	13.3	28.28	13.1

PTH Pure tone thresholds, *HT* hypertension, *SD* standard deviation

insufficiency that occurs due to vascular occlusion caused by emboli, hemorrhage or vasospasm, and these happen because of a syndrome of hyperviscosity or microangiopathy caused by diabetes or hypertension, and the latter could, through histopathological mechanisms cause the sensorineural hearing loss [15, 16].

As to gender, there was a difference in the men to women ratio in both groups, due to the fact that we did not pair the sample—cases were taken at random, during regular medical visits. Many studies have shown the association between gender and hearing loss in relation to age [17, 18]. Dubno et al. [19], after a study that correlated age, gender and hearing acuity, reported that males had a significant age-related drop in their hearing acuity and speech recognition, while women did not show such pattern. Pearson et al. [20], after a longitudinal study involving 681 men and 416 women, without signs of specific hearing disorders, unilateral or noise-induced hearing loss, reported that there is a two-fold increase in the speed at which men

lose their hearing, when compared to women, showing that age and gender are indeed related to hearing loss even in groups without signs of noise-induced hearing loss.

In the present study, carried out with male individuals with ages varying between 45 and 64 years, the male gender proved to be an independent risk factor for hearing loss. This corroborates the studies that have reported a significant drop in hearing acuity for male individuals as they age.

Conclusion

Our present study confirms that there is a possible association between hypertension and increase in hearing threshold. Patients with hypertension have greater increase in hearing threshold as compared to those without hypertension. The increase in hearing threshold was most marked among those with grade 3 hypertension, particularly at higher frequencies.

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