

Association of hypertension and age-related sensorineural hearing loss among elderly: A cross-sectional study



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ABSTRACT

Background: Hearing loss (HL) has negative impact on quality of life. The prevalence of HL increases with age. **Aims and Objectives:** The present study was planned to explore the possible association of hypertension with age-related sensorineural HL (SNHL) in the elderly. **Materials and Methods:** This was a cross-sectional study done in the ENT Department of Great Eastern Medical School and Hospital, Srikakulam. Consecutive sampling method used. Sample size was considered using the formula – $4pq/l^2$ and 137 subjects from age group 60–75 years were included in the study. Hypertension was verified through a mercury sphygmomanometer and by a systematized questionnaire about hypertension and the use of medication for blood pressure. The hearing was assessed through threshold audiometric and audiological assessment. The study period: 4 months. All patients from the ENT department in the age group 60–75 years and who gave written informed consent were involved in the study. Participants with a history of ear surgery performed in the past, exposure to loud sounds, recently use of ototoxic drugs, patients with hearing aids, and ear diseases were excluded from the study. **Results:** Out of 137 subjects 52% had hypertension and 48% had no hypertension. Grade 1 hypertensives suffered from mild HL (7.9%), moderate HL (73%), severe HL (11%), and profound HL (7.9%). In Grade 2, hypertensives suffered from moderate HL (11%), severe HL (33.3%), and profound HL (55.5%). The P-value calculated by the Chi-square method was found to be <0.05 and an odds ratio of more than 1, showing a significant association between hypertension and an increase in HL. Moreover, also a statistically positive correlation of MAP and duration of hypertension with age-related SNHL in both ears. **Conclusion:** HL in the population under study suggested that hypertension is an accelerating factor of degeneration of the hearing apparatus along with age-related SNHL. Hypertension and ageing were significantly associated with the risk of HL. Patients with hypertension have a greater increase in hearing threshold as compared to those without hypertension.

Key words: Hearing loss; Hypertension; Hearing threshold

INTRODUCTION

Ageing is the accumulation of changes in an organism or object over time and in humans refers to a multidimensional process of physical, psychological, and social change. Ageing is a global reality. The World Health Organization (WHO) defines the elderly in developing countries as persons aged

60 years or over and in developed countries as persons aged 65 years or over.¹ The Worldwide life expectancy at birth was estimated in 2000 as being 65 years; for 2045–2050, the United Nations estimate a life expectancy of 74.3 years.²

Hearing loss (HL) is a factor that irrespective of the degree of commitment affects the quality of life and

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when acquired in adults, it appears gradually and may make the oral language receiving difficult.³ According to the standards from WHO, a patient with HL is defined as a person who is not able to hear at a threshold of 25 dB or better in both ears.⁴ Ear disease and hearing impairment are neglected public health problems in developing countries. The prevalence of HL increases with age and it is higher among males than females. Globally, the prevalence of hearing impairment is 35 dB HL for individuals aged 15 years and above is 12.2% for males and 9.8% for females. The prevalence of mild hearing impairment is 22.7% for adult males and 19% for adult females.⁵ However, 80% of deaf and hearing-impaired people live in low- to middle-income countries, 50% of which are avoidable through prevention, early diagnosis, and management.^{4,6,7}

In the adult population, studies confirmed that HL starts at about 40 years old, and increases progressively over the years, although there is a resemblance in the audiology 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.

Cardiovascular risk factors such as diabetes mellitus, hypertension, cigarette smoking, obesity, and hyperlipidemia have been indicated to be associated with HL in various studies.^{8,9}

The pattern of high-frequency sensorineural HL (SNHL) is also observed among hypertensive patients.¹⁰ Most adult-acquired HL has a gradual onset and may impair oral language reception also.

In an experimental study using rats with arterial hypertension, it was noted that hypertension is an important risk factor for age-related HL. Action potentials, electrochemistry, and potassium concentrations in the cochlea of these genetically predisposed to hypertension animals were measured together with their normotension counterparts. With ageing, the hypertensive animals had a higher action potential threshold, a higher electrochemical potential happened only in the extremely aged animals, while potassium concentration increased not only in the endolymphatic cells but also in the perilymphatic ones.¹¹ These data suggest that ionic modifications to the cell action potential are involved in the hearing reduction that happens to hypertensive animals. These data help us understand HL in hypertensive individuals.¹² The symmetric SNHL has been observed within the patients, which could be due to microangiopathy of the inner ear or neuropathy of the cochlear nerve.^{13,14} Considering this background aim of the project is to study an association of hypertension with HL in the elderly.

Aims and objectives

To study an association of hypertension with age-related sensorineural hearing loss (SNHL) in the elderly.

MATERIALS AND METHODS

This cross-sectional study was conducted at the outpatient of ENT Department of Great Eastern Medical School and Hospital, Srikakulam from April 2019 to July 2019 after obtaining institutional ethics approval from the Ethics Committee in March 2019. Consecutive sampling method used. The sample size was calculated using the formula $n = 4pq/l^2$, p – prevalence—43.7, q —66.4, l —20% of p , taken from a study done on Indian population, with 95% confidence intervals. The sample size came to 116 but 137 subjects from age group of 60–75 years were included in this study.

Methodology

Hypertension was verified through mercury sphygmomanometer reading. After sufficient rest, an average of two readings was taken within a gap of 10 min. Data using a systematized validated questionnaire about hypertension and the use of medication for blood pressure were also collected. The hearing was assessed through threshold audiometric and audiological assessment.

Inclusion criteria

The following criteria were included in the study:

- Elderly that attended the ENT outpatient department with HL
- All volunteers in the age group 60–75 years
- Volunteers willing to give written informed consent.

Exclusion criteria

The following criteria were excluded from the study:

- Participants with a history of ear surgery performed in the past, exposure to loud sounds, recently use of ototoxic drugs, and ear diseases are excluded from the study.
- Patients with hearing aids
- Subjects with diabetes mellitus.

Institutional Ethics approval was obtained from the Ethics Committee in March 2019, before conducting the study.

Methods

The study was done in the ENT Department of GEMS and H. One hundred and thirty-seven subjects in the age group of 60–75 inclusive of both, after applying inclusion and exclusion criteria, were included in the study. Written informed consent and ethics approval were taken before the study. A systematic questionnaire was given to all subjects with HL to be filled to check if they were hypertensive or not. Ear examination, otoscopy and audiometry were done

on all subjects. The major variable of exposure was arterial hypertension and the outcome variable was HL.

Statistical analysis

Data were fed into an excel worksheet and analyzed using epi info 7 software using frequency distributions with proportions, and Chi-square test with P<0.05 is considered as significant, using 95% confidence intervals.

RESULTS

Table 1: A total of 137 subjects were included in our study of which 65 were control subjects (without hypertension) and 72 were diagnosed with hypertension of which 63 patients were diagnosed with Grade 1 hypertension according to the WHO classification for hypertension, nine patients were diagnosed with Grade 2 hypertension and no patients were diagnosed with Grade 3 hypertension.

In the present study, there was a mild HL in 20% of patients and 69% with moderate HL without hypertension. About 7.9% of patients with Grade 1 hypertension included in our study suffered from mild HL, 73% with moderate HL, 11% with severe HL, and 7.9% with profound HL. In Grade 2 hypertension, 11% were found to be suffering from moderate HL and 33.3% with severe and 55.5% with profound HL. Out of 137 subjects, 52% had hypertension and 48% had no hypertension.

Two-tail P-value of the Chi-square test was 0.004 with an odds ratio of -2.2.

The P-value calculated by the Chi-square method was found to be <0.05 and an odds ratio of more than 1, showing a significant association between hypertension and an increase in age-related SNHL.

Table 1: Grading of hypertension in study sample

Age	No hypertension	Grade 1	Grade 2	Total
60-65	46	20	3	69
66-70	18	23	4	45
71-75	01	20	2	23
Total	65	63	9	137

Male participants were predominated in our study (Graph 1). Grading of hearing loss in normal and hypertensives was presented in Graph 2 and Table 2.

Tables 3 and 4 show that there is a statistically positive correlation of MAP and duration of hypertension with the age-related SNHL in both the ears.

DISCUSSION

With ageing, there is a higher number of chronic diseases. Systemic arterial hypertension and HL have important prevalence in the elderly population.¹⁵ In this study, we observed that as the sample individuals were between 60 and 75 years, the higher age range proved to be an independent risk factor for HL. This is because, with age, there are structural alterations in the whole body, including the hearing system.¹⁶ Some studies justify that the SNHL that happens with ageing is related to a microcirculatory insufficiency that occurs due to vascular occlusion caused by emboli, hemorrhage, or vasospasm, and these happen because of a syndrome of hyperviscosity¹⁷ or microangiopathy caused by diabetes or hypertension, and the latter could, through histopathological mechanisms cause the SNHL.^{14,18} Hypertension may facilitate structural changes in the heart and blood vessels.¹⁹ High pressure in the vascular system may cause inner ear hemorrhage, which is supplied by the anterior inferior cerebellar artery²⁰ which supports the inner ear artery and is divided into the cochlear artery and anterior vestibular artery, which may cause progressive or sudden HL.^{19,21} Arterial hypertension may cause ionic changes in cell potentials, thus causing HL.¹¹

The present study showed the existence of an association between HL and arterial hypertension in individuals aged between 60 and 75 years, and the prevalence of HL was 92%, with 13% having a mild degree of HL and 67% having a moderate degree of HL and 6.5% severe and 7.2% profound HL. With increase in grade of hypertension, the severity of HL also increased showing that hypertension accelerates the HL in the elderly this result agrees with a study conducted by Lin et al.,²² who observed a prevalence of HL of 63.1% among the 717 participants that were enrolled in their study. Their study was conducted among older adults, aged 70 years and

Table 2: Distribution of grading of hypertension with the age-related SNHL

Age (years)	Normotensive					Grade I					Grade 2				
	No HL	Mild	Mod	Severe	Prof	No HL	Mild	Mod	Severe	Prof	No HL	Mild	Mod	Severe	Prof
60-65	5	10	31	0	0	0	2	14	3	1	0	0	0	1	2
66-70	2	2	14	0	0	0	1	18	3	1	0	0	1	2	1
71-75	0	1	0	0	0	0	2	14	1	3	0	0	0	0	2

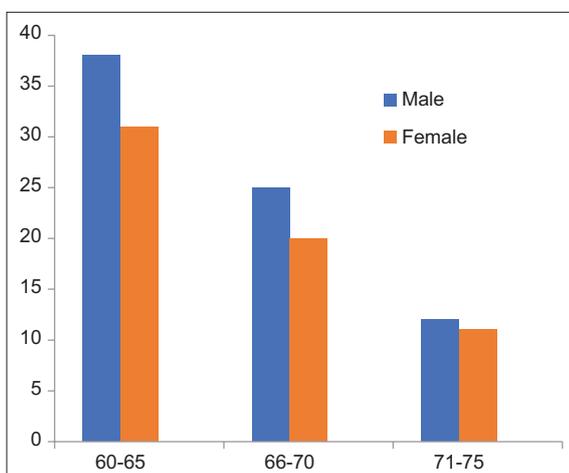
Table 3: Distribution of hearing loss in the study sample

	Hearing loss present	Hearing loss absent
Hypertension present	72	0
Hypertension absent	58	7

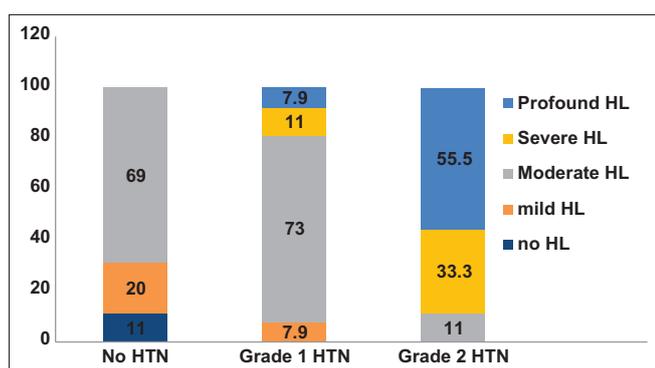
Table 4: Pearson correlation of MAP and duration of hypertension with SNHL

MAP (mmHg)	SNHL (dB)	r-value	P-value
102±6.8	45±16 (left ear)	+0.22	<0.05
102±6.8	45.4±17 (right ear)	+0.18	<0.05
Duration			
3.8±1.8	45±16 (left ear)	+0.1	<0.05
3.8±1.8	45.4±17 (right ear)	+0.24	<0.05

MAP: Mean arterial blood pressure



Graph 1: Male participants predominated in our study with an average of 65.8%



Graph 2: Grading of hearing loss in normal and hypertensives

above. The high prevalence of HL observed could have been due to age-related HL among their participants. Age was associated with an increased risk of HL in this study. This is in agreement with a study conducted by Dawes et al.,¹⁵ reported that age is a significant risk factor for hearing impairment. Starck et al.,¹⁶ also reported age to

be the most significant risk factor for SNHL among the 370 participants they assessed.

However, further multivariate analysis including age, and HL, indicated age was not a predictor of HL. This is in agreement with findings by Agarwal et al.,¹² who studied participants in the National Health Nutrition Examination Survey (NHANES) from 1999 to 2002 in the USA. They observed that age did not have any significant effect on the risk of hearing impairment after further analysis. The older a participant is the more risk factors of HL, he/she is exposed to. Thus, although age was not observed to be a predictor of HL in this study, the older participants might have had a higher hearing threshold due to exposures to other risk factors of HL.

In this study, 52% of participants had hypertension. Hypertension was associated with an increased risk of HL (OR 2.2; 95% CI). Agarwal et al.,¹² and Lin et al.,²² reported associations between hypertension and the risk of hearing impairment in their studies, both of which were prospective. They, however, observed a higher prevalence of hypertension among their participants (27% in the study conducted by Agarwal et al., and 30.8% prevalence in the study conducted by Lin et al.). Starck et al., further corroborated these findings in their study where they reported that diastolic blood pressure affected hearing impairment.¹⁶ Similar results were also found in the recent international studies concluding that hypertension acts as an accelerating factor in the development of age-related SNHL.^{23,24}

Due to a reduction in mortality rates, there is an increase in life expectancy all over the world. The major factors that affect health today are the chronic diseases caused by genetics, lifestyle, the environment and ageing itself; thus, we should focus our attention on the past years of the life of our patients aiming at increasing the number of healthy elderly, capable of maintaining their physical and mental functions until close to death.

The new challenges are the chronic conditions related to ageing, many detectable and preventable already in middle age, and such conditions are currently seen in the many health-care specialties in delaying those. Fries sees this as “morbidity compression,” in other words, live a life with relative health and compress diseases to a short period right before death.²⁵ It is necessary to adopt principles and strategies for preventive care and health maintenance aiming at improving their life quality.²⁶⁻²⁸

Among such preventive care, we should take care of the onset, as the many problems accruing from arterial hypertension, among which we mention HL. High blood

pressure is multicausal and multifactorial, and it involves the need to form a multidisciplinary care team. Physicians, nurses, technicians, nutritionists, psychologists, social workers, community agents, physical education teachers, pharmaceuticals, administrative personnel and the speech, and hearing therapist should all be part of the team.

Since arterial hypertension has proven to be a risk factor for HL, and such onset should be checked in this population, the speech, and hearing therapist, as the one responsible for hearing assessment should be included as an effective member of such a multiprofessional team involved with arterial hypertension.

The care related to arterial hypertension and hearing will certainly serve to avoid the frustrations caused by the reduction in one's capacity to understand oral language caused by a reduction in hearing acuity which may happen to arterial hypertensive individuals.²⁹⁻³¹

Limitations of the study

The present study was done in a village Ragolu an interior area of Andhra Pradesh. The population was mostly illiterate with no proper follow-up and control of hypertension. Most of them had a long duration of risk factors. HL was attributed to age rather than the risk and subjects were non-compliant to regular follow-up or treatment. There were other risk factors such as smoking, poor diet, and inhalation of chemical toxins due to the presence of chemical factories within a 50 m radius. These issues were not addressed in this study.

CONCLUSION

Since the study has shown that arterial hypertension is an independent risk factor for HL, besides advanced age, we highlight the importance of preventive processes that may mitigate the mechanisms that cause degeneration of the hearing apparatus caused by circulatory problems, most specifically high blood pressure. A larger population-based study is needed with multivariate analysis including other cardiovascular risk factors such as diabetes mellitus, BMI, cigarette smoking, and exposure to chemicals.

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HTR- Concept and design of the study and prepared first draft of the manuscript; **MJP**- Interpreted the results, reviewed the literature, and manuscript preparation; and **SSKG**- Concept, coordination, statistical analysis and interpretation, preparation of manuscript, and revision of the script.

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