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Study of Loss of Auditory Asymmetry in Presbyacusis

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Abstract

Introduction: Hearing loss is a social problem affecting worldwide resulting in significant health issues, communication difficulties, social withdrawal, isolation, dependence, frustration, and is strongly associated with, cognitive decline, depression and decreased quality of life [1]. Age related hearing loss (Presbycusis) [2] starts from 5th decade of life.The proposed mechanisms are lesions in the inner ear and cochlear nerve, and the loss of hair cells and spiral ganglion neurons (SGNs) [3]. In adults, the auditory function has asymmetries in right and left side resulting in right ear advantage over the left. Asymmetry at the cochlear level is called as peripheral right ear advantage and those involvingprocessing complex in brain is called central right ear advantage. In adults the cochlea of right ear is sensitive and it's affected more than left. *Aim:* Toevaluate theloss of auditory asymmetry and loss of right ear advantage in presbyacusis. *Methods:* 100 subjects aged more than 55 years (divided in to 55-60, 61-65, and >65) are taken in this study. All are subjected to a pure tone audiometric assessment followed by evaluation of their right ear advantage over their left. *Results:* The auditory thresholds of right and left ear in aged individuals showed significant loss of right ear advantage in age groups of 61-65 and>65. *Conclusion:* Elderly subjects of age group greater than 60 have severity in left earsensorineural hearing loss in all frequencies. The study showed that there is a significant loss of right ear advantage in subjects greater than 60 years.

Keywords: Presbyacusis; Sensorineural Hearing Loss; Right Ear Advantage.

Introduction

Presbyacusis, (in Greek prebys = aged, and akousis = hearing). presbyacusis, is a complex degenerative disease affecting ten million people worldwide.

Hearing loss associated with senescence may be profound, affecting cognitive, social, functional, and psychological well-being of the person. According to world health organization (1984), the term aged or elderly refers to persons aged 60 years or above. The auditory system degenerates before this elderly age. Age related hearing loss is slowly progressive, bilateral and symmetrical [1-3] and is associated with the cochlear degeneration [4,5,6]. Human brain has anatomical and functional asymmetries in both right and left cerebral hemispheres. The human left and right cerebral hemispheres are asymmetric [6,7,8].

Aim of the Study

1. To evaluate the loss of right ear advantage in aged individuals using pure tone audiometry.
2. To compare pure tone audiometric results between right ear and left ear in aged subjects between 55-70 years of age.

Objectives of the study

1. To record pure tone audiometry in all aged individuals (55-60, 61-65, and >66 years).
2. To record pure tone audiometry in right and left ear separately.

3. To compare auditory acuity of both ears in aged individuals.
4. To analyze the loss of right ear advantage in aged individuals.

Materials and Methods

This study was performed in aged individuals greater than 60 years. They were divided into three age groups: 55-60, 61-65, and >65. A prepared questionnaire regarding hearing function, noise exposure, ear and hearing-related history, medical history, medication were used to analyze them.Pure tone audiometry was done in all age groups years after getting written informed consent from all participants or their guardians.An otoscopic examination was performed before all the tests to ensure that the ear canal was clear and that there were no obvious signs of middle ear infection or perforation in the tympanic membrane.After excluding subjects with apparent middle ear diseases after otoscopic examination, 100 subjects were included in this study.

Inclusion Criteria

1. Subjects aged 60 years or over.
2. No vestibular complaints and no history of otological surgery.

Exclusion Criteria

1. History of Outer and/or middle ear disease.
2. History of ototoxic drugs
3. Patients working in noisy environments without adequate auditory protection.
4. History of systemic diseases like diabetes and hypertension.

Audiological Tests

In all subjects nose, throat are completely examined and a detailed ear examination was performed to rule out external and middle ear abnormalities. Then Preliminary screening was done by tuning fork tests.

Tuning Fork Tests

These tests are done by three methods Rinne's, Weber's and Absolute bone conduction test using a tuning fork of frequency of 512 Hz and analysed as Air conduction and Bone conduction. Air conduction (AC) test is a measure of both conduction mechanism and cochlear function. Bone conduction is a measure of cochlear function [7].

Pure Tone Audiometry

An assessment of the hearings status using a pure tone audiometer (LABAT AUL 11036) is done. Ear phones are used to test hearing by air conduction and a small vibrator placed over the mastoid is used test hearing by bone conduction. All audiometers incorporate a calibration circuit, which allows the output sound level to be set at each frequency. The signals presented to the subject by an audiometer are characterized by its frequency, sound pressure level and wave form which are all controlled. The model has facilities for air and bone conduction with white noise masking and tone decay tests. The basic elements of the audiometer are patient tone generator, calibrator, switch, amplifier, attenuator switch and display [9].

Principle [9]:

An audiometer is an electronic device that produces pure tones, the intensity of which can be increased or decreased in 5-dB (Decibel) steps. Air conduction thresholds are measured for tones of 250, 500, 1000, 1500, 2000, 4000, 6000 and 8000 Hertz. Bone conduction thresholds are measured for 250, 500, 1000, 1500, 2000, 4000 Hertz. The amount of intensity that has to be raised above the normal level is a measure of the degree of hearing impairment at that frequency. It is charted in form of a graph called the "audiogram." The thresholds of bone conduction are a measure of the cochlear function. The difference in the thresholds of air and bone conduction (A-B gap) is a measure of a degree of conductive deafness. The audiometer is so calibrated that hearing of a normal person, both of air and bone conduction is at 0 dB and there is no A-B gap.

Sensorineural Hearing Loss: [9,1]

SNHL is indicated by raised air and bone conduction thresholds (both >25 dB) and the air bone gap does not exceed 10 dB.

Statistical Analysis

Pure tone thresholds were obtained from both ears separately by using LABAT AUL 11036. When a participant was unable to hear a tone, 5 dB above

the highest audiometer output level was recorded as the threshold. Data were presented as mean and standard deviation (SD) and evaluated with ANOVA (Analysis of variance). Statistical significance was assigned to P values of less than 0.01. A p value larger than 0.5 was considered as statistically insignificant.The data collected and analysed using epi-info (version 3.4.3) software package, SPSS and Excel software.

Results

Table 2, Figures 1 show the results in the right ear, Table 3 and Figure 2 show the results for left in all three groups. The auditory thresholds of right and left ear in aged individuals showed significant loss of right ear advantage in age groups of 61-65 and >65 suggestive of severity in left ear sensorineural hearing loss than the right ear. There was no effect of gender on the hearing thresholds of right and left ear in elderly subjects

Table 1: WHO Classification of hearing loss

WHO Classification (1980) of degree of hearing loss	
Normal	0-25 dB
Mild	26-40 dB
Moderate	41-55dB
Moderately severe	56-70dB
Severe	71-91dB
Profound	> 91 dB

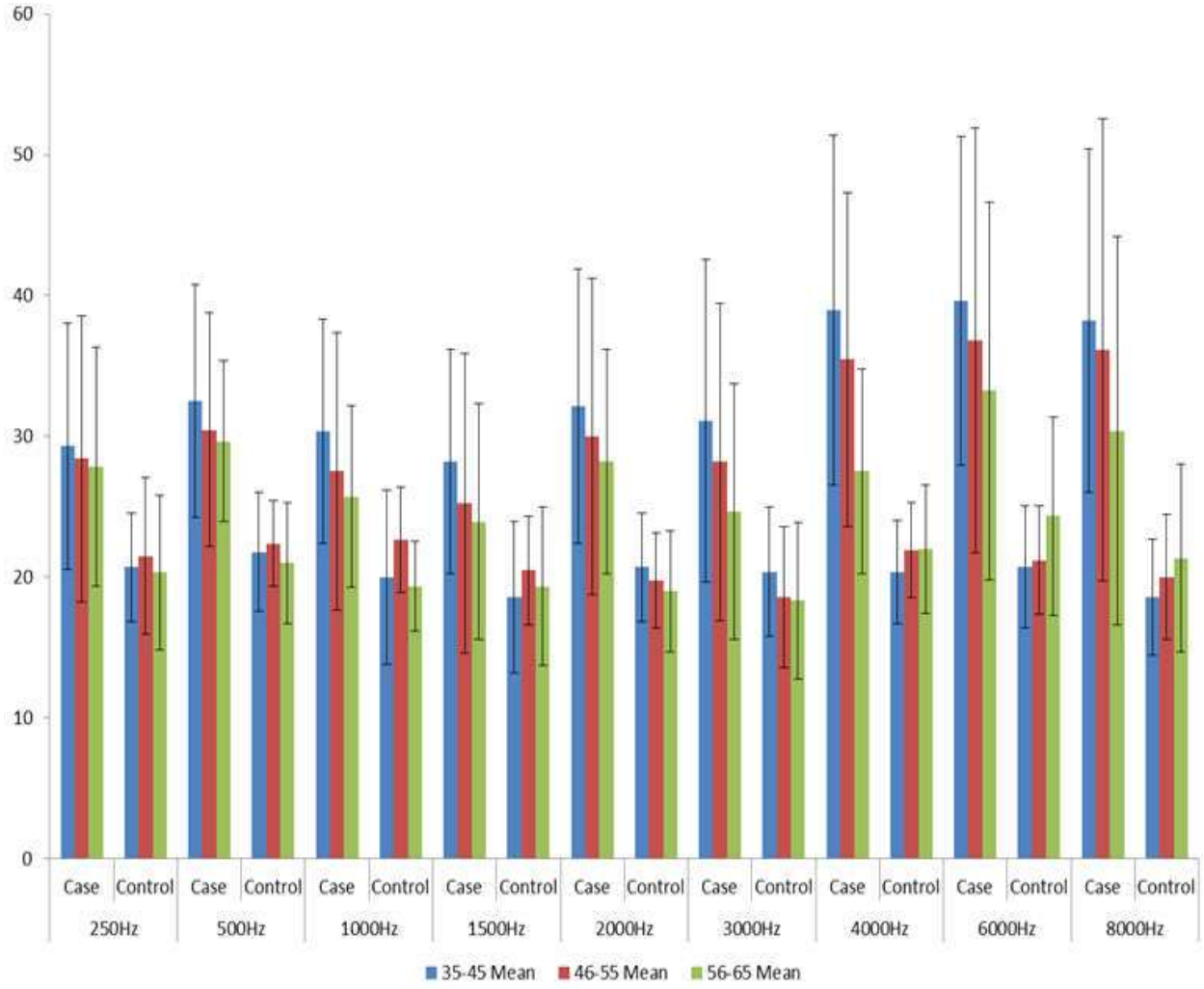

Chart 1: Right ear hearing threshold

Table 2: Right ear hearing threshold

Right	Group	Age class I Mean (dB)	I Std. Deviation	II Mean (dB)	II Std. Deviation	III Mean (dB)	III Std. Deviation	ANOVA p-value
250Hz	Case	32.86	8.93	27.05	8.40	32.50	7.78	0.072
	Control	22.14	3.78	22.14	4.35	22.33	4.17	0.989
500Hz	Case	35.36	6.34	30.00	7.56	33.93	7.89	0.085
	Control	22.14	4.26	23.33	2.89	23.67	4.42	0.525
1000Hz	Case	32.86	9.35	27.95	7.54	31.07	9.03	0.327
	Control	20.71	6.16	21.90	3.35	22.00	5.92	0.743
1500Hz	Case	27.50	9.15	25.91	8.82	27.86	7.77	0.769
	Control	20.71	6.16	22.14	3.73	19.67	6.67	0.401
2000Hz	Case	29.64	6.92	28.18	7.07	30.71	9.78	0.716
	Control	21.07	4.46	21.90	4.02	20.33	6.40	0.643
3000Hz	Case	27.14	5.45	26.36	6.60	27.86	6.39	0.902
	Control	19.29	3.85	22.14	3.73	19.00	6.87	0.112
4000Hz	Case	35.36	5.93	34.55	5.23	33.57	6.47	0.925
	Control	20.36	3.65	21.90	3.70	22.00	6.49	0.565
6000Hz	Case	36.07	7.80	39.09	8.61	42.86	9.19	0.452
	Control	20.71	4.32	20.48	3.50	20.67	7.04	0.989
8000Hz	Case	35.00	6.56	38.41	7.26	36.43	7.73	0.767
	Control	18.21	3.17	19.29	4.27	21.00	7.12	0.332

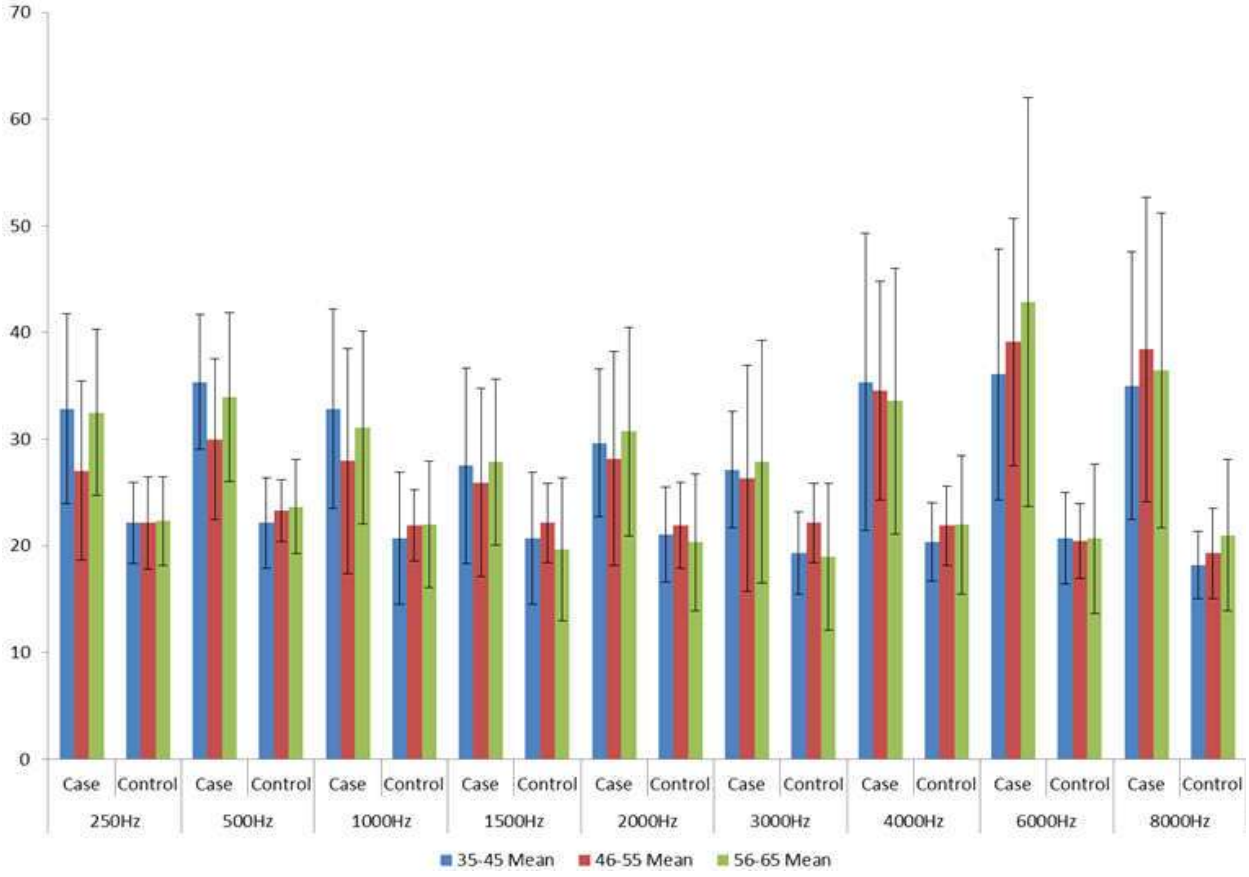

Chart 2: Left ear hearing threshold

Table 3: Left ear hearing threshold

Left	Group	Age class I Mean (dB)	I Std. Deviation	II Mean (dB)	II Std. Deviation	III Mean (dB)	III Std. Deviation	ANOVA p-value
250Hz	Case	29.29	8.74	28.41	7.16	27.86	8.48	0.920
	Control	20.71	3.85	21.48	5.55	20.33	5.50	0.792
500Hz	Case	32.50	8.26	30.45	8.30	29.64	5.71	0.594
	Control	21.79	4.21	22.38	3.01	21.00	4.31	0.562
1000Hz	Case	30.36	7.96	27.50	9.85	25.71	6.46	0.352
	Control	20.00	6.20	22.62	3.75	19.33	3.20	0.071
1500Hz	Case	28.21	7.99	25.23	7.63	23.93	8.36	0.462
	Control	18.57	5.35	20.48	3.84	19.33	5.63	0.513
2000Hz	Case	32.14	9.75	30.00	8.23	28.21	7.99	0.586
	Control	20.71	3.85	19.76	3.35	19.00	4.31	0.482
3000Hz	Case	31.07	6.47	28.18	7.29	24.64	9.09	0.296
	Control	20.36	4.58	18.57	5.04	18.33	5.56	0.500
4000Hz	Case	38.93	6.43	35.45	6.84	27.50	7.27	0.024
	Control	20.36	3.65	21.90	3.35	22.00	4.55	0.425
6000Hz	Case	39.64	7.68	36.82	7.08	33.21	6.39	0.469
	Control	20.71	4.32	21.19	3.84	24.33	7.04	0.115
8000Hz	Case	38.21	6.19	36.14	8.40	30.36	7.79	0.338
	Control	18.57	4.13	20.00	4.47	21.33	6.67	0.360

Conclusion

Elderly subjects of age group greater than 60 have severity in left ear sensorineural hearing loss when evaluated with a pure tone audiometer in all frequencies than the group less than 60 years showed right ear advantage. The study showed that there is a significant loss of right ear advantage in subjects greater than 60 years. On ageing, this right ear advantage is lost due to compromises in blood supply to cochlea resulting in severe left ear hearing impairment than right ear [10]. Further studies involving follow up of the control group over a period of years may improve our understanding of the pathology involved.

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