Pattern of Pure Tone Audiograms in Presbyacusis

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ABSTRACT: AIM: To investigate the degree and configurations of hearing loss on pure tone audiometry in presbyacusis. STUDY DESIGN: Prospective PLACE AND DURATION: Shalamar hospital, Lahore September 2010 to May 2011. SUBJECTS AND METHODS: One hundred and twenty nine (N=129) consecutive subjects, sixty years of age or above, presenting with hearing impairment underwent pure tone audiometry. Demographic characteristics of the patients were noted. The subjects with external and middle ear disease, with history of noise/ ototoxic trauma were excluded from the study. The results were reported in terms of degree and pure tone configuration of hearing loss (HL). RESULTS: All subjects showed symmetrical sensorineural hearing loss on pure tone audiometry. The levels of hearing deficit varied between mild and profound and the frequency of mild, moderate, severe, and profound hearing impairment were found to be 26.3%, 43.4%, 18.6%, 11.6% respectively. Males and females were affected equally. The pure tone average hearing loss showed more loss on high frequencies. The average air-bone gap was 5 dB. Out of 129 cases, 62 % had downsloping (56.4% were gentle sloping and 43.5% showed flat pattern) and 2.3% showed u shaped configuration. CONCLUSION: We found greater number of a gentle high-frequency sloping audiogram followed by flat configuration and the degree of loss varied from mild to profound, with a prevalence of moderate degree. No significant differences were observed in the audiometric profile in men and women. Key Words: Presbyacusis, pure tone audiometry, deafness, hearing loss, sensorineural.

INTRODUCTION: Diminished organ function due to degenerative processes is more commonly seen now a days because the population is becoming progressively older. This is due to health awareness programmes on one hand and the advanced health facilities on the other. Hearing loss associated with increasing age is known as presbyacusis. The term presbyacusis comes from the Greek “presbys” meaning “old” and “(a)kousis” meaning “hearing,” and is referred to as symmetrical HL associated with the degenerative processes of ageing. Toynbee in 1849 was perhaps the first to write about age-related HL. Zwaardemaker in 1891 is credited with the first accurate description of presbyacusis. Since the 1930s, age-related changes have been observed at nearly every location in the ageing auditory system, from the external ear with collapsing canals to neural degeneration extending from the auditory nerve. The pattern of HL in elderly patients reveals definitive variations in the degree and form of hearing as well as in time of onset and rate of progression. The durability of auditory mechanism is determined mainly by genetic factors and by the physical stress to which it is subjected during daily life. Hearing impairment can result in anxiety or stress in everyday life. In many patients in which there is not much tonal loss on pure tone audiogram, their main problem is speech perception and discrimination. Rehabilitation of such patients is possible but is underused. According to the AAO-HNS definitions of hearing the average HL at 0.5, 1, 2, and 3 kHz must exceed 25 dB to be considered a hearing handicap. The incidence of hearing loss increases with age. The predictable deterioration in hearing ability that occurs with age varies in severity from mild to substantial and if not rehabilitated isolation, depression, and, cognitive decline. The audiological testing plays an important role in advising the most appropriate aid. Our search failed to find any study conducted in Pakistan on audiogram pattern amongst the elderly subjects. We conducted this study to assess the pure tone thresholds and audiogram configuration in ageing patients. SUBJECTS AND METHODS: This study was carried out in the Audiology unit of the Shalamar Hospital, Lahore from September 2010 to May 2011. All new subjects (N=129) sixty years of age or above, presenting with hearing impairment underwent pure tone audiometry were included. Demographic characteristics of the patients were noted. Their mean age was 68.33 years (SD=7.558, range 60-95). There were 72 males and 57 females. Audiometric assessments were done using the equipment- MAICO MA 41 66961. The project was approved by the Hospital Ethics Committee and written consent was obtained from all the subjects. Complete history was taken to rule out any other cause of HL. The patients with external and middle ear disease and with history of noise and ototoxic trauma were excluded from the study. According to the classification, the frequencies of 0.25, 0.5, 1 and 2 KHz were considered low frequencies; and 4, and 8 KHz were considered high frequencies, and the type of hearing loss was noted and the degree of hearing loss were analyzed from their mean values. Audiometric testing was performed at 250, 500, 1000, 2000, 4000, 8000 Hz. Hearing levels were measured in decibels. The degree of HL was reported according to international standards for hearing:

Normal hearing = 0-25 dB.
Mild HL = 26-40 dB
Moderate HL = 41-55 dB

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RESULTS: Pure tone audiograms of 129 subjects were analyzed. Positive correlations were found between age and hearing impairment. All patients showed symmetrical sensorineural hearing loss on pure tone audiometry. The levels of hearing deficit varied between mild and profound and the frequency of mild, moderate, severe, and profound hearing impairment were found to be 26.3%, 43.4%, 18.6%, 11.6% respectively. The pure tone average hearing loss (PTA, average of 0.5, 1 and 2 kHz) ranged from 15 to 70 dBHL with a median of 40 and when high frequencies included, ranged from 15 to 100 with a median of 55 dBHL, thus indicating more loss on the high frequencies. The average air-bone gap was 5 dB. No significant differences were found between males and females. Out of 129 cases, 62% had down sloping (56.4% were gentle sloping and 43.5% showed steep slope), 26.3% had flat pattern of audiogram, 2.3% showed u shaped (cookie bite) configuration.

DISCUSSION: Age related HL or presbyacusis is one of the common presentations of elderly patients. When assessing a patient with hearing impairment, the most simple and most widely available technical investigation is pure-tone audiometry. Standard audiometry is performed by a method of limits in which brief pure tones are presented through headphones at a variety of frequencies and sound pressure levels and the subject indicates when the tones are audible. Intensities are presented in an ascending or descending sequence at each frequency of interest until the threshold has been determined. Routinely thresholds are determined at octave interval from 125 to 8000 Hz. Bone conduction (BC) is carried out by a small bone vibrator placed against the mastoid process. Proper testing requires careful masking of the non-test ear for a bone conduction transducer placed on any part of the skull, because there

Figure 1: Descending pattern. (See text)

Figure 2: Flat pattern.

Figure 3: Gradual descending pattern.

Figure 4: Abrupt descending pattern.
is less than 5 dB attenuation between the two ears. It is equally important in air conduction (AC) testing when the interaural threshold difference in AC is 40 dB or more. Although it is a subjective measure, the test is very reliable if the subject is compliant. An emphasis has been laid on the reliability and age gender specific values when interpreting the pure tone thresholds8. Presbyacusis is not a single pathophysiological entity20. Moreover, ageing of the auditory structures does not affect all persons of the same age in the same manner, but varies from individual to individual20. The issue of presbyacusis has been debated for more comprehensive definition44. Presbyacusis is characterized by four distinct degenerative conditions and their corresponding distinct audiometric patterns in their purest manifestation. Sensory presbyacusis refers to epithelial atrophy with loss of sensory hair cells and supporting cells in the organ of Corti. Auditory thresholds correspond with the degree of hair cell damage in the cochlea and is characterized by abrupt descending PTA. (Fig.1) Neural presbyacusis refers to atrophy of nerve cells in the cochlea and central neural pathways. Audiometrically, neural presbyacusis is manifested as disproportionate tonal thresholds with speech discrimination is poorer than auditory thresholds on PTA. On pure tone audiometry, it is characterized by downward sloping audiogram with variable slope. (Fig.2) Metabolic (strial) presbyacusis results from atrophy of the stria vascularis. Flat audiometric profiles have been reported to be associated with the stria vascularis atrophy. (Fig.3) Mechanical (cochlear conductive) presbyacusis is based upon both clinical and pathological criteria. The audiogram must show a gradual descending pure tone thresholds over a range of at least five octaves, a difference of at least 50 dB between the best and the poorest thresholds and no more than 25 dB difference in any octave range. (Fig.4) This results from thickening and secondary stiffening of the basilar membrane of the cochlea and lead to alteration in the cochlear motion mechanics28. Another variant is mixed presbyacusis and is associated with significant pathological changes in more than one auditory structures. Various possible combinations are described by Shucknecht28. Sensory with strial presbyacusis will cause an abrupt high frequency loss superimposed on a flat threshold loss. A sensory with cochlear conductive presbyacusis would present an audiogram having an abrupt loss for the high frequencies superimposed on a descending threshold loss. Strial and cochlear conductive will show a gradual descending slope superimposed on a flat threshold loss. In cases in which cochlear pathology does not reach any significant level in any of the structure and when pure tone threshold does not meet the criteria for typical sloping pattern are classified as indeterminate presbyacusis. In one study, conducted by Blanchet, Pommie and colleagues, distribution of pure-tone hearing thresholds of a Caucasian population living in the south of France aged 70 years and older were documented. They concluded that hearing thresholds, especially in high frequencies, increased with age more and this was more pronounced in women than in men. They however included the parameters of ototoxic and noise exposure in their study28. In our study, high frequency loss was common to both men and women. The distribution of sensorineural hearing was studied by Lutman and Coles, however found Inter-aural threshold differences greater than attributable to measurement error in older subjects28. A study conducted by Roth, Hanebuth and colleagues, revealed roughly 30% of men and 20% of women in Europe to have a HL of 30 dB HL or more by age 70 years, and 55% of men and 45% of women by age 80 years28. Ogunleye and Labaran, however, found that presbyacusis affect both males and females subjects almost equally22. We found no significant difference in the distribution of SNHL in men and women.In one study by Bunnag and Prasansuk et al, hearing screening performed using pure tone audiometry in elderly people showed abnormal hearing level in considerable number of subjects. A significant number of subjects had bilateral moderate to severe degree of hearing impairment. They however, found no difference in the hearing thresholds between males and females or between right and left ears28. There is no known therapy for presbyacusis and this is an important problem in society. Early detection of hearing impairment in elderly persons can benefit them by amplification from properly fitted hearing aid and hence helps definitely improve their quality of life and may prevent various psychiatric and functional impairments common in such subjects.

CONCLUSION: We found greater number of high-frequency gentle sloping followed by flat configurations. The degree of loss varied from mild to profound, with a prevalence of moderate degree. No significant differences were observed in the audiometric profile in men and women. We anticipate that this pilot study will help to provide basic data for the study of this very common but neglected clinical entity.

REFERENCES: