An investigation into hearing loss among patients of 50 years or older

JI Fei, LEI Lei, ZHAO Su-ping, LIU Ke-fang, ZHOU Qi-you, YANG Shi-ming
Department of Otolaryngology/ Head and Neck Surgery, Chinese PLA Institute of Otolaryngology, Chinese PLA General Hospital, 28 Fuxing Road, Beijing 100853, China

Abstract Objects To investigate the extent of hearing loss in an elderly sample population to estimate hearing disorders among the age-equivalent population in China and to study primary clinical characteristics of presbycusis.

Methods Clinical data from 110 hearing loss patients of both senium and pre-senium ages (95 males and 15 females, mean age = 74.4±12.1 years) were reviewed. Patients aged from 50 to 59 years were accepted as the pre-senium control group (n=15). The 95 senium patients (> 60 years of age) were divided into 4 groups according to age: 60+ group (60 to 69 years, n=25), 70+ group (70 to 79 years, n=26), 80+ group (80 to 89 years, n=32) and 90+ group (90 years or older, n=12). Pure tone audiometry thresholds were measured in all 110 patients. Hearing loss severity of each tested ear was rated according to the Goodman classification criteria. Besides, audiometric configuration was examined in each ear. Results Audiometric testing showed normal hearing in 65 ears (29.5%), slight to moderately severe hearing loss in 131 ears (59.5%), and severe and profound loss in 24 ears (11%). Air-bone gaps were found in 12 ears (5.45%) indicating conductive hearing loss. Except the 12 ears with conductive hearing loss, audiograms showed gradually sloping loss in 99 ears (45%), sharply sloping loss in 34 ears (15.45%), flat loss in 45 ears (20.45%), notch pattern loss in 5 ears (2.27%), trough and rising pattern loss in 2 ears (0.91%), total deafness in 2 ears (0.91%), and normal hearing in 21 ears (9.55%). On average, hearing thresholds increased at a rate of approximately 10 dB per 10 year for subjects aged 60 and older. Conclusions Hearing thresholds tend to be stable in presbycusis patients aged from 50 to 70 years, increase significantly between 70 and 80 years of age, and reach another stable stage at high levels after 80 years of age, especially in high frequencies. Hearing loss in middle frequencies accounts for most of recession in loudness perception.

Key words elderly; presbycusis; hearing loss

Introduction

Presbycusis is the third most common chronic disease in the world, which seriously affects the quality of life in older people. The main clinical manifestations of presbycusis include symmetrical and slowly developing sensorineural hearing loss, high pitched tinnitus and speech recognition disorders. As the result of economic growth and improved health care, China is gradually becoming an aging society. Hearing loss is one of the most impacting chronic diseases on the quality of life in the Chinese elder population. In clinical practice, an increasing number of older patients complain of their communication disorders induced by hearing loss. On the other hand, there is a long way to go in epidemiological data collection and analysis regarding presbycusis. In view of this, we have focused on this population and conducted systematic research. This article will report our primary results of hearing investigation in patients who are 50 years or older and complain of hearing impairment.

Materials and Methods

Subjects

A survey was done in 110 patients (95 males and 15 females) over the age of 50 years with hearing loss as the chief complaint. The male to female ratio was 6.3 :
1. The age ranged from 50 to 96 years, with a mean age of 74.4 years and a standard deviation of 12.1 years. The subjects were divided into five groups: pre-senium control group (50 to 59 years, n=15), 60+ group (60 to 69 years, n=25), 70+ group (70 to 79 years, n=26), 80+ group (80 to 89 years, n=32) and 90+ group (90 years or older, n=12). History of the following diseases was excluded from all the patients participating in this study: genetic deafness, congenital deafness, drug-induced hearing loss, sudden deafness, noise-induced hearing loss, infections and systemic disease-related hearing loss.

**Test methods**

All participants received pure tone audiometry testing with a GSI61 audiometer in sound proof booth with ambient noise level in compliance with national standard GB/T 16403 Acoustics—Audiometric test methods—Basic pure tone air and bone conduction threshold audiometry. Both air and bone conduction thresholds were tested on each patient, using calibrated TDH 39 earphones and B-71 bone vibrator respectively. Test procedures followed GB/T16403. For each patient, the claimed better ear was tested first and then the other ear. Air conduction threshold was measured first using Hughson-Westlake procedure and then bone conduction. The frequencies testing sequences was 1 kHz, 2 kHz, 4 kHz, 8 kHz, 500 Hz and 250 Hz in air conduction, and 250 Hz, 500 Hz, 1 kHz, 2 kHz and 4 kHz in bone conduction. The hearing loss severity of each ear was rated according to the classification criteria by Goodman as: total deafness, profound hearing loss, severe hearing loss, moderately severe hearing loss, moderate hearing loss, slight hearing loss, and normal hearing (Table 1). The audiometric configuration of all tested ears was characterized as: conductive (Figure 1-A), gradually sloping (Figure 1-B), sharply sloping (Figure 1-C), flat(Figure 1-D), notch (Figure 1-E), trough and rising (Figure 1-F), total deafness, and normal.

<table>
<thead>
<tr>
<th>Classification</th>
<th>Criterion</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total deafness</td>
<td>No response</td>
<td>2</td>
</tr>
<tr>
<td>Profound</td>
<td>&gt;91dB</td>
<td>1</td>
</tr>
<tr>
<td>Severe</td>
<td>71–90dB</td>
<td>21</td>
</tr>
<tr>
<td>Moderately severe</td>
<td>56–70dB</td>
<td>31</td>
</tr>
<tr>
<td>Moderate</td>
<td>41–55dB</td>
<td>65</td>
</tr>
<tr>
<td>Slight</td>
<td>26–40dB</td>
<td>35</td>
</tr>
<tr>
<td>Normal hearing</td>
<td>&lt;26dB</td>
<td>65</td>
</tr>
</tbody>
</table>

Note: Classification criteria are based on those reported by Goodman (1965)

Table 1 Distribution of hearing loss severity

**Figure 1 Audiometric Configurations**

A: Conductive hearing loss  B: Gradually sloping  C: Sharply sloping  D: Flat loss  E: Notch  F: trough and rising
Results

Average air conduction thresholds in different age groups for each octave frequency are listed in Table 2. According to the Goodman criteria (Table 1), of all the 220 ears, the test showed normal hearing in 65 ears (29.5%), mild to severe hearing loss in 131 ears (59.5%) and worse than severe hearing loss in 24 ears (11%) (Figure 3).

Hearing thresholds at each frequency were compared among age groups using rank-sum test. The significance was adjusted to 0.005 due to repeated use of rank-sum test. There was no significant difference between 50+, 60+ and 70+ age groups at all 6 frequencies except an age-associated deterioration at 8 kHz ($P < 0.005$). Thresholds in patients older than 70 years increased dramatically at all frequencies ($P < 0.005$), with those in patients older than 80 years significantly higher than those in the 70+ group ($P < 0.005$). No significance was found between 80+ and 90+ age groups at 250 Hz, 2 kHz, 4 kHz, and 8 kHz (Figure 2).

Concerning the audiometric configuration, 12
(5.45%) ears showed conductive hearing loss with obvious air-bone gap (Figure 1A). For the other ears, the configuration was gradually sloping (Figure 1B) in 99 ears (45%), sharply sloping (Figure 1C) in 34 ears (15.45%), flat (Figure 1D) in 45 ears (20.45%), notch–shaped (Figure 1E) in 5 ears (2.27%), trough and rising (Figure 1F) in 2 ears (0.91%), total deafness in 2 ears (0.91%) and normal hearing in 21 ears (9.55%) (Figure 4).

Discussion

Survey data have showed that there are about 130 million elderly people in China, 11% of the total population. It is expected that the elderly population will increase to more than 400 million around the year of 2040. Hearing impairment is a major issue the elderly are faced with. Calculated from the results of second National Sample Survey on Disability, there are more than 13 million elderly patients suffering from presbycusis. In people between 65 and 75 years of age, about 30% have hearing loss, while in people older than 75 years this proportion is higher than 50%. The main clinical manifestations of presbycusis include symmetrical and gradually increasing sensorineural hearing loss, high frequency tinnitus and speech recognition disorders. These will bring a series of psychological and emotional distress to the elderly, such as depression, loneliness, anxiety, irritability, etc., thereby affecting quality of life in older persons. Two major factors affect the incidence of presbycusis.
of presbycusis. First, industrialization and urbanization bring about high level environmental noises which can do chronic harm to hearing. Second, with the increase of people’s life expectancy, the impact of aging on the auditory system becomes increasingly prominent. There is a strong need to investigate the status of elder people with hearing loss in China. We have investigated into hearing loss among Chinese elder adults who are over 50 years old and complain of hearing impairment, in order to understand general characteristics of this population. In this paper, the preliminary results are reported.

The mechanism and inducement of presbycusis is complex. In 1988 a work group of the Committee on Hearing and Bioacoustics and Biomechanics (CHABA) of the National Research Council published a report on speech–understanding problems in the elderly. In this report, the etiology and risk factors of presbycusis were comprehensively summarized: Understanding of presbycusis may be flawed because physiological, pathological, and environmental factors all undoubtedly contribute to age–related hearing loss. Presbycusis is the sum of various types of hearing loss that result from several varieties of physiological degeneration. The degeneration can result from noise exposure, exposure to ototoxic materials, systemic medical disorders (such as arteriosclerosis, hypertension, renal disease, diabetes mellitus), and treatment of these disorders. Potential sites of disorders have been identified as peripheral–auditory, central–auditory, or cognitive systems. The complexity in mechanisms and causes of hearing loss in elderly patients leads to a wide variety of audiometric configurations. Such complexity can be seen from the results of this paper. In addition to conductive hearing loss with air–bone gap, other configurations included gradually sloping, sharply sloping, flat, notch, trough and rising curves, total deafness and normal hearing. Variability in hearing loss profiles reflects effects by various impacting factors in different individuals.

In this paper, elderly subjects of different ages were investigated. It can be seen from Table 2 and Figure 1 that hearing loss in elder adults generally shows a gradual deterioration especially in high frequencies. Hearing loss is mild in the mid and low frequency area, but moderate to severe in high frequency area. Pure tone thresholds increase gradually along with age at a rate of about 10 dB/10year. Lee et al analyzed pure–tone thresholds in 188 elder adult human subjects to study longitudinal changes in thresholds over a period of 3 to 11.5 years. Subject initial ages ranged from 60 to 81 years, and pure–tone thresholds at 0.25 to 8 kHz were measured. It was concluded that on average, hearing threshold increased approximately 1 dB per year for subjects aged 60 and over, which was similar to our results. Lee et al suggested that the rate of change in thresholds could be affected by age, gender, and initial threshold levels. Pure tone thresholds at 0.25 to 3, 10, and 11 kHz in female subjects over 70 years changed faster than in female subjects aged 60 to 69 years, while those in older male subjects changed faster at 6 kHz than in younger male subjects. Females had a slower rate of threshold change at 1 kHz and faster at 6 to 12 kHz than males. Subjects with higher initial thresholds at low and mid frequencies tended to have faster changing rate at 0.25 to 2 kHz, and those with higher initial thresholds at mid and higher frequencies tended to have slower changing rate at 6 to 8 kHz in the following years.

From the current investigation, some preliminary conclusions can be drawn. (1) Thresholds remain stable from 50 to 70 years of age, except a significant deterioration along with age at 8 kHz. (2) Thresholds increase dramatically at all frequencies after 70 years of age. (3) Between the 80 + and 90 + age groups, most threshold changes are at only 500 Hz and 1 kHz but not at high frequencies, indicating stable high–frequency hearing sensitivity in patients over 80 years of age. The decline in mid and low frequencies may lead to a significant decline in perception of loudness.

Acknowledgement

This work has been supported by the grants from Hi–Tech Research and Development Program of China (973) (#2011CBA01000), National Natural Science Foundation of China (NSFC) (#30871398, 30730040).

References


(Received May 27, 2011)