Hearing impairment in older people: a review

Lisa Fook, Rosemary Morgan

As we age we are increasingly likely to suffer from chronic conditions. Hearing impairment is among the top three such conditions along with arthritis and hypertension.[1] It may have become a problem for the first time in old age or may have been acquired when younger or at birth. Prevalence figures illustrate the size of the condition. The prevalence of 45 decibels (dB) (moderate whisper) or greater hearing loss in the better ear in the UK population has been estimated as 3.8%. In those aged 61–80 years old the prevalence of conductive hearing loss of 45 dB or greater in the better ear is 3.1% and the prevalence of sensorineural hearing loss of at least 45 dB in the better ear is 14.3%.[2] Looked at another way 90% of those with a hearing loss of 45 dB average in the better ear are over 52 years old, and for milder degrees of hearing loss a staggering 35% of those over 50 are afflicted.[3] Not only is hearing impairment common,[4] but also frequently disabling and it is essential that all clinicians who care for elderly patients are familiar with its recognition and methods of amelioration.

Box 1: Causes of hearing impairment

- Hereditary disorders
- Metabolic disease
- Ototoxic drugs
- Trauma
- Excess noise
- Neoplasms
- Infections
- Vascular damage
- Degenerative disease (presbyacusis)

Box 2: Pathological patterns of presbyacusis

- Degeneration of hair cells in the cochlea
- Loss of spiral ganglia and nerve fibres of the cochlear nerve
- Atrophy of the stria vascularis, which alters properties of the endolymph
- Degeneration of inner ear support components

Aetiology

There are two main types of hearing loss: conductive and sensorineural. Any impediment to the transmission of sound waves through the external ear canal and middle ear as far as the footplate of the stapes results in conductive hearing loss—for example, perforation of the ear drum and fixation of the ossicular chain (otosclerosis). Sensorineural hearing impairment results from a defect in the cochlea, the cochlear nerve or more rarely in the central neural pathways. Within these two broad categories there are numerous conditions which may contribute to hearing impairment in the older adult, some of which may also affect younger adults (box 1). These include metabolic disease—for example, diabetes mellitus and hypothyroidism, ototoxic drugs—for example, aminoglycosides and loop diuretics, trauma, excess occupational and recreational noise, neoplasms—for example, acoustic neuroma, hereditary disorders—for example, otosclerosis (autosomal dominant), infections—for example, chronic suppurative otitis media and Ramsey-Hunt syndrome, vascular damage and degenerative disease (commonly referred to as *presbyacusis*). Presbyacusis is a term used to describe the insidious, progressive, bilateral, and symmetrical impairment of hearing of sensorineural origin which is associated with increasing age. Structural changes in the inner ear are most contributory to this. Four distinct patterns of presbyacusis have been identified (box 2).[5] In addition there are age related changes in the auditory brainstem pathways and auditory cortex which can lead to central processing difficulties. Although such distinct pathological varieties and subsequent patterns of sensorineural hearing loss are recognised, many older patient's hearing impairment can be shown to be due to a combination, in varying degrees, of these types.[6]

Auditory assessment

If hearing impairment is suspected an appropriate history and examination should be performed. The clinician needs to note if one or both ears are affected, the rate of onset, previous employment, history of ingestion of any potentially ototoxic drugs,[7] and the presence of any of the major symptoms of ear disease. These are pain (otalgia), discharge (otorrhoea), a sensation of abnormal movement (vertigo), and inappropriate noise in the ear (tinnitus). It is important to rule out dementing and affective disorders since confusion and inattention may be misinterpreted as evidence of hearing impairment.

Examination should include ensuring that the external canal is not obstructed and the tympanic membrane has a glistening translucent greyish appearance. Tuning fork tests can differentiate conductive and sensorineural hearing impairment (box 3). In Rinne's test a tuning fork (256 or 512 Hz) is struck and held in front of the ear and then applied still vibrating to the mastoid process behind the ear. With normal hearing the fork is heard loudest in front of the ear but if the patient has a conductive hearing impairment it will be heard loudest when applied to bone. In Weber's test the tun-

Arrowe Park Hospital, Upton Road, Wirral, Merseyside L69 5PE, UK
L Fook
R Morgan

Correspondence to:
Dr Morgan

Submitted 21 September 1999
Accepted 7 December 1999

Box 3: Auditory assessment tools
- Self assessment questionnaires
- Forced whisper test
- Tuning fork tests—Rinne, Weber
- Audiometry—pure tone, speech

Box 4: When to refer to an ear, nose, and throat surgeon
- Sudden onset
- Unilateral
- Tympanic membrane not seen/abnormal
- Basic examination suggests conductive hearing loss
- Symptoms of tinnitus and vertigo

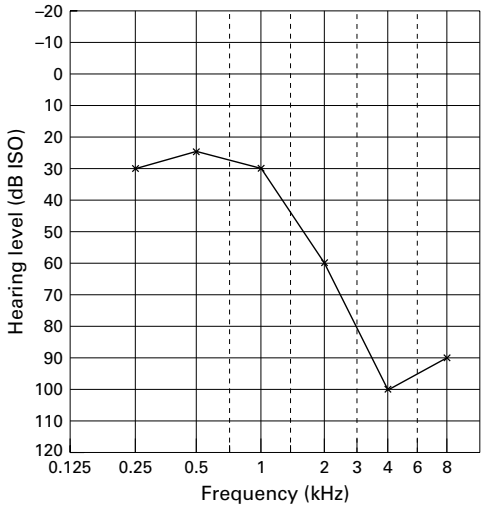

Figure 1 Pure tone audiogram.

ing fork is placed on the centre of the forehead and the patient is asked in which ear they hear the fork best. With sensorineural hearing loss the fork will be heard best in the better hearing ear, and for a patient with conductive hearing loss it is perceived best in the affected or worst affected ear.[8]

For those over 60, if the hearing impairment appears to be progressive, bilateral and sensorineural in origin, general practitioners (GPs) and hospital clinicians may make direct referral to hospital audiology departments. However, if hearing loss is of sudden onset or unilateral, the tympanic membrane cannot be seen clearly or looks abnormal, examination suggests conductive hearing loss, or there is a history of any of the worrying symptoms of ear disease then an initial referral to an ear, nose, and throat surgeon is more appropriate (box 4), so that potentially treatable causes of hearing loss can be excluded and treated (although for GPs some conditions may be within their scope).

Audiologists administer hearing tests using electronic equipment. In pure tone audiometry individual tones of different frequencies are presented at various intensities to each ear via bone and air conduction. The patient signals when they become aware of the tone. An audiogram can be plotted to show the threshold for each frequency. Pure tone audiometry can determine the severity of hearing loss and identify conductive loss or a conductive component. In speech audiometry speech perception is measured by recording how many phonetically balanced words are heard correctly when presented at different intensities. Patients with conductive hearing loss may score 100% if the words are presented at high intensity. Its main use is in distinguishing sensory (defect in cochlea) hearing loss from neural hearing loss since each produce characteristic speech audiograms.

In prebyacusis, characteristically the pure tone audiogram slopes at high frequencies (fig 1).[9] There is decreased sensitivity to pure tone over about 1000 Hz (greatest in men) and a decline in the low frequency threshold (greatest in women).[10] Older people with presbyacusis, although often able to hear people talking, have difficulty understanding what is being said. Ordinary speech is carried out in the range of frequencies 250–6000 Hz and 2–60 dB loudness. Certain consonants are high in pitch but low in loudness—for example, "sh", "t", and "k". Vowels, like background noise, are lower in pitch and higher in loudness. Audibility of the consonants is critical to understanding speech. Since, in presbyacusis, the high frequency consonants will not be heard, speech will be perceived in a distorted fashion, and this will be exacerbated in a noisy room. In this situation hearing aids work by bringing the high frequency, low intensity consonants into the audible range without amplifying the already audible vowels and background noise.

It is vital to remember that the audiometric tests described provide a quantitative measure of hearing loss but do not reflect how such a loss impacts on an individual's life. There can be a surprising variation in the effects on communication, social, and emotional function for the same degree of hearing loss.

Psychosocial consequences of hearing impairment

Hearing impairment may be perceived by older people as a social stigma and they may fail to seek help for fear of being labelled "deaf and daft". Many also regard it as an inevitable and irremediable part of aging. If help is sought at all there is often significant handicap, and the patient may report problems going back for up to 20 years.[11] Disability, handicap, and reduced quality of life occur in many areas.[12 13] Older people may avoid going out and taking part in leisure activities. Paranoid tendencies may be accentuated and the individual may become anxiety ridden or withdrawn and depressed. Relationships with family and friends may become strained. Because individuals may not be aware of auditory signals—for example, smoke alarms, sirens, doorbells, and have difficulty using a telephone, their physical safety and indeed their ability to live independently may be jeopardised. Watts believed that delete-

rious effects on communication are the major negative impact of disabling hearing impairment.[14] Adequate reception of a message is paramount to successful communication. It has been shown that hearing impairment can interfere with a patient's understanding of their management.[15] This may lead to non-compliance with drugs and other therapeutic interventions. Older individuals who have a degree of hearing loss may have difficulty monitoring their own speech, which subsequently deteriorates and worsens the overall communication problem.[16] To compensate for their hearing loss elderly people may break conventional rules of personal space which may hamper their social relationships. Since they have to concentrate intensely to try and piece together what is being said, they may have difficulty in thinking beyond the immediate communication with a laborious conversation ensuing. As a result the older people may prefer to withdraw from social discourse and yet there is much we can do to help those affected.

Screening

Since hearing impairment in the elderly is common, has major adverse effects, those affected often fail to seek help and yet there are a number of effective devices available, several authors have emphasised the need for screening in the elderly.[11 17–19] Simple, validated, and reliable questionnaires which serve to identify those who are disabled as a result of their hearing loss such as the hearing handicap inventory for the elderly, and the forced whisper test are inexpensive and speedy tools which can be used in general practice. Those identified by questionnaires as regarding their hearing impairment as a problem are more likely to utilise and benefit from a hearing aid regardless of the degree of hearing loss.[20] The forced whisper test is a clinical test whereby patients are asked to repeat numbers or words whispered at varying distances from their ear. A standard whisper is achieved by whispering after a normal (that is, not forced) expiration. The other ear must be adequately masked and the eyes shielded. In the study of John *et al* a hearing aid was accepted by 84% of patients whose forced whisper distance was 70 cm or less.[21]

Hearing aids

Hearing loss of almost any extent can be ameliorated with a hearing aid. For conductive hearing loss this is simply a matter of amplification, although for sensorineural hearing loss the mechanism is more complex. However, there are many factors which will interfere with a patient's satisfaction with, and benefit from, a hearing aid. Lack of motivation because of fear of stigmatisation, low expectations of benefit, or failure to accept there is a problem remain significant obstacles.[22] Stephens *et al* showed that despite the fact that 50% of those aged 50–65 in two villages in South Wales had a hearing disability only 7% had a hearing aid.[23] Clinicians have an important role in identifying those who would benefit from a hearing aid and emphasising the benefits of its use.

Box 5: Hearing aid styles

- Behind-the-ear (BTE)
- In-the-ear (ITE)
- In-the-canal (ITC)
- Body worn aids

Figure 2 Behind-the-ear aid in place.

Hearing aids should have electroacoustic characteristics which make speech audible but comfortable. All consist of a microphone, which converts acoustic signals to electrical signals, an amplifier which selectively processes the output signals, a receiver which converts the electrical signal back to an acoustic signal, and an earmold and tubing to deliver this to the patient's ear. All hearing aids available on the NHS are behind-the-ear types (although it is common practice to supply some other aids to war veterans whose hearing impairment is due to bomb blasts).In behind-the-ear aids the microphone, amplifier, and receiver are in a crescent shaped plastic case that rests behind the ear. A small tube connects this to the earmold (figs 2 and 3). This style remains popular with older people as it can provide higher gain and the larger controls are easier to manipulate. For those with severe hearing impairment or manual dexterity problems larger devices are needed, but these can be worn quite unobtrusively attached to clothing (fig 4). Also available on the market from registered dispensers are in-the-ear and in-the-canal styles (box 5).

On most hearing aids there are three switch positions: **O**, **T**, and **M** (fig 3). At the **O** position the hearing aid is **o**ff, and **M** denotes the **m**icrophone is on. At the **T** position (**t**elecoil on) the aid can pick up signals from

Figure 3 Behind-the-ear aid showing the earmold and plastic case.

Figure 4 Body worn hearing aid.

transmitting devices—for example, certain telephones and loop systems which are now incorporated into the majority of concert halls, theatres, and customer service points at post offices and banks. A sympathetic hearing scheme symbol (ear with a line through it) denotes a loop system is in operation.

A frequently encountered problem is a constantly whistling hearing aid. The clinician must exclude a canal blocked with wax, and ensure the hearing aid has not become unseated before referral for audiological reassessment. Like dentures, hearing aids may become loose when patients loose weight and new earmolds may need fitting. Quality of life improvements with hearing aids occur after six weeks and can be shown to be sustained after one year.[12] Such benefits are comparable in younger and older adults.[24]

Aural rehabilitation

This comprises methods of amplification (provision of hearing aids and instruction in their use), and the maximisation of communication skills (box 6).

Patients must be counselled to understand that the aid does not allow them to hear normally but will enable them to have less difficulty understanding others. This will not happen overnight and patients need to be aware that it will take some time for them to get used to certain patterns of sound made louder. Where available, group orientation programmes have proved useful in increasing the benefits obtained by new hearing aid users.[25]

In addition to being supplied with hearing aids patients also need to be taught how to improve their communication skills. This may involve speech reading, learning to listen (listening is an active process unlike hearing), tuition to maintain good quality speech, and instruction on how to utilise visual clues such as facial and body gestures.[26] Speech and language therapists have a significant role in the teaching of speech conservation and lip reading classes are taught by audiologists or at adult education centres.

Box 6: Aural rehabilitation

Amplification

- Provision of hearing aid
- Instruction and counselling in its use

Maximisation of communication skills

- Lip reading
- "Learning to listen"
- Speech conservation
- Utilising visual clues

Box 7: Environmental aids

- Sound enhancement
- Telecommunications
- Television enhancement
- Signal alerting

Environmental aids

To distinguish words and sounds hearing aid users need the primary signal to be significantly louder than the background noise. This is feasible if the speaker is close and background noise is at a minimum. At home older people can ask visitors to come closer and switch off the television. However in restaurants, theatres, and noisy wards where the doctor may stand at the foot of the bed the listening environment can be very taxing. It is important for patients and doctors to realise that turning up the volume may make matters worse. Assistive listening devices or environmental aids are invaluable in such circumstances. These fall into four categories (box 7).[27] An example of sound enhancement technology, a voice amplifier, was used in the study of Fook *et al*.[15] With sound enhancement technology the signal (such as speech from an individual or sound from a television) is transmitted directly to the ear of the individual via hardwire, radiotransmission, or infrared. The problems of environmental noise and distance are thus avoided. The voice amplifier or communicator is a an example of a hardwired system. These are relatively inexpensive and are ideal for use when being interviewed by professionals in a ward environment.[15] Radiosystems may be used when speaker and listener are in different rooms, and the receiver may be incorporated into a behind-the-ear aid. Infrared systems are most suited for transmission from media such as televisions and stereo systems (as in concert halls).

Box 8: Learning points

- Hearing impairment is common
- It has adverse effects on psychosocial function
- Elderly people often fail to seek help
- There is considerable unmet need for hearing aids
- This need will rise as the elderly population increases
- Doctors must play a vital part in identifying those affected and referring for assessment

Built in amplifiers can be used to help those with hearing impairment use the telephone. Even despite these measures some elderly people still have difficulty discriminating speech over the telephone. The boom in home computers and email (not the sole province of the young!) has been a blessing in such circumstances. Telecaptioning, where dialogue is displayed across the bottom of the television screen, is another helpful visual adaptation, while a vibrating pillow, which notifies someone it is time to get up, or flashing doorbells are examples of a signal alerting devices. Audiologists who specialise in environmental aids can provide advice to individuals and institutions about all such devices, and they can be supplied to individuals through social services departments.

Conclusion

Hearing impairment is one of the commonest chronic conditions encountered in old age. It can have devastating effects on an individual's social life, independence, and emotional health. Unfortunately, older people often fail to seek help, believing it is an inevitable part of aging or fearing stigmatisation. Even though there are a number of measures and devices which can significantly improve an affected individual's quality of life, there is considerable unmet need for these and as the older population rises this need will rise also. It is therefore essential that doctors recognise disabling hearing loss, treat where necessary, and refer to appropriate professionals (box 8).

1 Adams P, Benson.V. Current estimates from the National Health Interview Survey 1991. *Vital Health Statistics* 1984;10.
2 Davis A. Epidemiology. In: Kerr AG, ed. *Scott-Browne's otolaryngology.* Vol 2. Stephens D, ed. *Adult audiology.* London: Butterworth-Heinmann, 1997: 1–38.
3 Davis A. Epidemiology of hearing disorders. In: Kerr AG, ed. *Scott-Browne's otolaryngology.* Vol 2. Stephens D, ed. *Adult audiology.* London: Butterworths,1987: 90–126.
4 Naramura H, Nakanishi N, Tatara K, *et al.* Physical and mental correlates of hearing impairment in the elderly in Japan. *Audiology* 1999;**38**:24–9.
5 Schuknecht H, Igarski K. Pathology of slowly progressive sensori-neural deafness. *Transactions of the American Academy of Ophthalmology and Otolaryngology* 1964;**62**:222–42.
6 Schuknecht HF, Gacek MR. Cochlear pathology in presbyacusis. *Ann Otol Rhinol Laryngol* 1993;**102**(suppl 158):1–16 .
7 Chermak G, Jinks M. Counselling the hearing impaired older adult. *Drug Intelligence and Clinical Pharmacy* 1981;**15**: 377–82.
8 Blakley BW, Siddique S. A qualitative explanation of the Weber test. *Otolaryngol Head Neck Surg* 1999;**120**:1–4.
9 Wiley TL, Cruickshanks KJ, Nondahl DM, *et al.* Aging and high frequency hearing sensitivity. *Journal of Speech and Language and Hearing Research* 1998;**41**:1061–72.
10 Moscicke E, Elkins E, Baum H, *et al.* Hearing loss in the elderly: an epidemiologic study of the Framingham Heart Study Cohort. *Ear Hear* 1985;**6**:184–90.
11 Stephens SDG, Meredith R, Callaghan DE, *et al.* Early intervention and rehabilitation: factors influencing outcome. *Acta Otolaryngol* 1991;**476**:221–5.
12 Mulrow C, Aguilar C, Endicott J, *et al.* Quality of life changes and hearing impairment: results of a randomised trial. *Ann Intern Med* 1990;**113**:188–94.
13 Scherer MJ, Frisina DR. Characteristics associated with marginal hearing loss.and subjective wellbeing amongst a sample of older adults. *Journal of Rehabilitation and Research* 1998;**35**:420–6.
14 Watts WJ. Human development and communication. In: Watts WJ, ed. *Rehabilitation and aquired deafness.* London: Croom-Helm, 1988: 26–49.
15 Fook L, Morgan R, Sharma P, *et al.* The impact of hearing on communication. *Postgrad Med J* 2000;**76**:92–5.
16 Parker A. Speech conservation. In: Watts WJ, ed. *Rehabilitation and aquired deafness.* London: Croom-Helm, 1983: 234–50.
17 Weinstein.BE. Geriatric hearing loss: myths, realities, resources for physicians. *Geriatrics* 1989;**44**:42–60.
18 Sangster JF, Gerace TM, Seewald RC. Hearing loss in elderly patients in a family practice. *Can Med Assoc J* 1991;**144**: 981–98.
19 Cohn ES. Hearing loss with aging: presbycusis. *Clin Geriatr Med* 1999;**15**:145–61.
20 Fino M, Bess F, Lichtenstein M, *et al.* Factors differentiating elderly hearing aid wearers and non-wearers. *Hearing Instruments* 1991;**43**:6–10.
21 John G, Davies E, Stephens D. Predicting who will use a hearing aid. *Practitioner* 1989;**233**:1291–4.
22 Kemp B. The psychosocial context of geriatric medicine. In: Kemp K, Brummel-Smith K, Ramsdell J, eds. *Geriatric rehabilitation.* Boston: Little Brown, 1990.
23 Stephens SDG, Callaghan DE, Hogan S, *et al.* Hearing disability in people aged 50–65: effectiveness and acceptability for rehabilitative intervention. *BMJ* 1990;**300**:508–11.
24 Primeau R. Hearing aid benefit in adults and older adults. In: Weinstein B, ed. *Seminars in hearing*. New York: Thieme, 1997.
25 Weinstein BE. Disorders of hearing. In: Tallis R, Fillit H, Brocklehurst JC, eds. *Brocklehurst's textbook of geriatric medicine and gerontology*. London: Churchill Livingstone, 1998: 678–84.
26 Gravell R. *Communication problems in elderly people: practical approaches to management.* London: Croom Helm, 1988: 86.
27 Flexer C. Access to communication environments through assistive listening devices. *Hearsay* 1991;**6**:9–14.