How to Treat. PULL-OUT SECTION





NEED TO KNOW

Hearing loss is classified as conductive, sensorineural, or mixed.

Though hearing loss is prevalent, it should not be viewed as a normal part of ageing. Identification and treatment of hearing loss helps improve quality of life.

Age-related hearing loss is the most common cause of hearing loss in the elderly, but there are numerous other differential diagnoses.

Note the association between age-related hearing loss and dementia, and encourage patients to seek treatment for their hearing loss. Screen for cognitive decline as indicated.

Refer for specialist assessment in cases of asymmetric sensorineural hearing loss, any conductive hearing loss, neurologic deficits, severe otologic symptoms, profound hearing loss and difficulty hearing despite well-fitted hearing aids.

Hearing aids are often prescribed once it has been decided there is no further medical or surgical intervention. Devices have differing indications and specific eligibility requirements.

Hearing loss in the elderly



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BACKGROUND

ONE in six Australians are currently affected by hearing loss, and as many as one in four are anticipated to be affected by 2050 as the population ages.¹ Hearing loss affects 37% of adults older than 60 and 80% of adults older than 80.²

Globally, the burden of hearing loss is significant, with more than 5% of the world population (360 million people) experiencing disabling hearing loss.³ According to WHO estimates, there may be as many as 500 million people over 60 with age-re-

lated hearing loss by 2050.3

with hearing difficulties.⁵

Hearing loss remains underrecognised and undertreated. It is estimated that only one in four of those who would benefit from a hearing aid have one.¹

Although ARHL is the overwhelming cause of hearing loss in the elderly, there are myriad other potential causes that require recognition and appropriate referral for specialist management. The aim of this How to Treat is to review the aetiologies, workup, and management of elderly patients presenting with hearing loss. In addition, it aims to raise awareness among GPs of the strong association between hearing loss and incident dementia within the elderly population. The types of hearing loss are outlined in table 1. and hearing loss was first described in 1989, when a case-control study demonstrated a greater prevalence of hearing loss in 100 patients with Alzheimer's disease vs 100 matched controls without dementia.⁶

In 2011, a landmark prospective study demonstrated a strong association between pre-existing hearing loss and risk of dementia onset.⁷ The study found that untreated hearing loss increased the risk of dementia onset by approximately 35%. those with established dementia do not show the same reversal effect.¹¹ Though the data is preliminary, it would seem to suggest that earlier identification and treatment of hearing loss may have a protective effect against dementia onset.

The prevalence of hearing loss and cognitive impairment is likely to continue increasing over time due to the increasing ageing population. It is therefore vital for GPs to be aware of the link between dementia and hearing loss. Evaluate elderly patients for hearing loss and cognitive function and refer for appropriate management.

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Copyright © 2020 Australian Doctor Group All rights reserved. No part of this publication may be reproduced, distributed, or transmitted in any form or by any means without the prior written permission of the publisher. For permission requests, email: howtotreat@adg.com.au Age-related hearing loss (ARHL) is the most common cause of hearing loss in the elderly and typically begins its onset in the sixth decade of life. Men tend to have earlier onset and greater severity when compared with women.⁴ ARHL can impair the ability to effectively communicate and makes it particularly difficult to hear clearly in the presence of competing background noise. Studies have demonstrated reduced quality of life in those

ASSOCIATION WITH DEMENTIA

UNTREATED hearing loss is becoming increasing recognised as a contributor to and exacerbating factor for dementia. The association between dementia Additional research has examined the impact of correcting ARHL on cognition. While the data is not yet definitive, studies have optimistically demonstrated that treating ARHL can have positive effects on global cognitive function, with treated patients frequently improving on cognitive testing.^{8,9} This has been shown in those with traditional hearing aids as well as cochlear implants.^{9,10}

The benefit, however, seems to be limited only to those with mild cognitive impairment. Studies examining the effect of hearing rehabilitation on

HISTORY

PERFORM a focused otologic history and examination in patients presenting with a primary complaint of hearing difficulty. Quantify the duration and severity of the hearing loss. Patients are often accompanied by family members or caregivers who can provide supplemental history regarding the impact of hearing loss. ►

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Ask about other otologic symptoms (see box 1). Accompanying tinnitus is very common. Aural fullness or pressure and otorrhea may point to the possibility of infection or cholesteatoma.True vertiginous symptoms with concomitant hearing loss may point to etiologies such as Meniere's disease, labyrinthitis, or perilymph fistula.

Assess the risk factors for hearing loss. These include the accumulation of loud noise exposure over one's lifetime, occupational exposures, use of hearing protection, history of otologic trauma, or head trauma. Ask about a family history of hearing loss. Perform a medication review to evaluate for possible ototoxic exposure (see box 2, list is not exhaustive).

The functional impact of hearing loss is critical, as it relates to the daily experience of the patient. Patients typically complain of increasing difficulty hearing, especially when competing background noise is present. Therefore, seemingly normal hearing in a one-on-one quiet clinic setting should not automatically reassure the GP of normal hearing function.

Hearing loss is also almost ubiquitously associated with some degree of subjective tinnitus. Tinnitus associated with hearing loss can occasionally be significantly debilitating and can be severe enough to cause depression and even suicidal ideation. Refer patients who complain of pulsatile tinnitus or pulse-synchronous tinnitus for evaluation of possible organic pathology.

EXAMINATION

PERFORM an otoscopic examination in a stepwise fashion. Abnormalities in the pinna may suggest congenital anomalies within the middle and inner ear. Inspect the external auditory canal (EAC) for abnormalities excessive cerumen, exostoses, evidence of trauma, or otitis externa. Pay special attention to the status of the tympanic membrane (TM) and middle ear, assessing the TM for any pathology - evidence of trauma, retraction pocket, perforation, erythema, effusion, or opacification.

Perform a cursory audiometric evaluation with a tuning fork. The most commonly used frequency is a 512Hz fork. A Weber's test is performed by placing the fork in the midline such as the forehead, vertex, or even the incisors. If the sound of the tuning fork localises to one side, it may imply a conductive loss on the ipsilateral side or a sensorineural loss on the contralateral ear. A Rinne test can be done by placing the fork approximately 2cm lateral to the EAC, and then onto the bony prominence of the mastoid tip. Air conduction is normally greater than bone conduction (AC>BC), while a reversal of this find ing (BC>AC) may suggest conductive pathology.



Table 1. Types of hearing loss

Category	Features	Audiometry
Conductive hearing loss (CHL)	Pathologies which impair transmission of sound from the outer and middle ear into the inner ear are classified as conductive causes of hearing loss. Examples include cerumen impaction, tympanic membrane (TM) perforation (see figure 1), otosclerosis, otitis media, and ossicular chain pathology	On audiometry, there is a gap between the air and bone conduction curves, termed the air- bone gap, or ABG
Sensorineural hearing loss (SNHL)	SNHL occurs when, in the absence of conductive pathology, the inner ear has a reduced threshold of audiologic detection. This may be due to a variety of histopathologic processes (such as loss and damage of hair cells, atrophy of spiral ganglion cells, endolymphatic hydrops)	On audiometry, the air and bone conduction curves overlap, but are in the hearing-impaired threshold range
Mixed hearing loss	Both conductive and sensorineural hearing loss are present	

thresholds at 0.5, 1, 2 and 3kHz.¹²

The audiogram provides information about the sidedness, severity, and type of hearing loss (see figure 2). The configuration of the audiogram can alert the clinician towards possible etiologies (see figure 2).

Other components of audiometry include tympanometry and speech recognition testing. These may offer additional clues to the etiology of hearing loss. The severity of hearing loss is classified based on the thresholds listed in table 2.

Speech testing

Speech testing provides a more representative test of daily hearing function compared with pure-tone audiometry. Within speech testing, there are threshold and supra-threshold tests

Speech reception threshold (SRT) is the lowest intensity at which a patient can correctly identify 50% of bisyllabic words (for example, 'hot dog' or 'popcorn'). The SRT should match the PTA closely and SRT is often used to corroborate the PTA. Major discrepancies between SRT and PTA may point to non-organic hearing loss (that is, malingering). Speech discrimination scores provide valuable audiologic information with respect to higher-level auditory processing. Words and sentences are presented at supra-threshold levels, that is, 40dB above the patient's PTA, or the highest comfortable hearing level. Speech discrimination scores may highlight hearing loss that would otherwise have been missed by pure tone audiometry alone.

recognition testing suggests a retrocochlear lesion or significant cochlear loss. In these patients, speech performance will not improve despite increasing the volume.

A third type of speech test is the hearing-in-noise test (HINT). As the name suggests, the patient is challenged with a sentence presented with varying loudness of background noise. This data is useful to evaluate binaural hearing function. HINT is commonly used as a criteria test for cochlear implant candidacy (HINT score of less than 50% in best aided conditions is an indication for cochlear implant), as well as post cochlear implant performance testing.

DIFFERENTIAL DIAGNOSES

THERE are multiple causes of hearing loss (see table 3). When evaluating a patient with hearing loss, an organised approach will help to arrive at the correct diagnosis.

MANAGEMENT BY AETIOLOGY Presbycusis

AGE-RELATED hearing loss (ARHL) is by far the most common form of hearing impairment in the elderly population.3 ARHL, also known as 'presbycusis' or 'presbyacusis', refers to progressive irreversible decline of hearing function due to accumulating damage of the outer hair cells within the cochlea. This typically presents initially as a bilateral symmetric high-frequency SNHL, which can progress to involve the entire frequency range. The major consideration in the management of presbycusis is the patient's degree of functional impairment. Mild non-impairing presbycusis can often be monitored with serial annual to biennial audiograms, but those struggling with day-to-day function may need hearing amplification, such as PAGE 18

Table 2. Audiometry thresholds

Severity	Threshold
Normal	<25dB
Mild	26-40dB
Moderate	41-55dB
Moderate-severe	56-70dB
Severe	71-90dB
Profound	>90dB

Source: Ahsan S et al 2014¹³

Box 1. Other otologic symptoms

- Difficulty hearing especially in
- competing noise environment Tinnitus – can be mild to debilitating
- Aural fullness sensation that the ears are 'blocked', or 'underwater'
- Otorrhoea
- Vertigo efforts should be made to differentiate 'lightheadedness/dizziness' (non-otologic) from true rotatory vertigo (otologic)

Box 2. Common ototoxic medications

- Platinum-based chemotherapeutic agents
- Cisplatin, carboplatin Aminoglycosides
- Gentamicin, streptomycin, tobramycin, amikacin
- Other antibiotics
- Vancomycin, chloramphenicol, erythromycin
- Loop diuretics
- Furosemide

Box 3. Otoscopic examination checklist

- External auditory canal
 - Presence and amount of cerumen
 - Masses: exostoses, osteomas, polyps
 - EAC skin: otitis externa, otomycosis, dermatitis
- Tympanic membrane
- Retraction pocket
- Perforation: dry vs wet, central vs marginal
- Plaques and opacification: tympanosclerosis.
- cholesteatoma
- Middle ear
- Fluid: serous (minimal drum oedema) vs acute otitis media (painful red bulging TM)

INVESTIGATIONS Pure tone audiometry

THIS is the gold standard for evaluating hearing. An audiologist evaluates a patient's hearing threshold at predefined frequencies to construct an audiogram. The threshold is defined as the loudness (in decibels - dB) of the tone which the patient can correctly identify 50% of the time. Based on the audiogram, a pure-tone average (PTA) can be calculated.

The American Academy of Otolaryngology - Head and Neck Surgery defines the PTA as the average of

Tympanometry

A sealed probe placed into the ear canal emits sound that is reflected back and measured, as the pressure within the ear canal varies. Based on acoustic reflection, the compliance of the tympanic membrane can be determined. The volume of the ear canal is also measured, which helps determine whether the TM is intact or perforated. Tympanometry typically results in three configurations (see box 4 and figure 3).

Poor performance in speech

Box 4. Tympanometry configurations

• Type A, normal: The peak compliance is at a normal range. • Type B, flat: This is seen in the presence of middle ear fluid (low ear canal volume) or tympanic membrane perforation (large ear canal volume).

Type C, negative: This is suggestive of chronic Eustachian tube dysfunction and the resultant negative middleear pressure.

▲PAGE 16 a hearing aid (see the general management section). Patients who are profoundly deaf may require cochlear implantation for hearing rehabilitation.

Cerumen impaction

Cerumen impaction is the one of the most common causes of conductive hearing loss in this population. Cerumen is produced by ceruminous and sebaceous glands in the glandular cartilaginous portion of the EAC. Impaction can occur due to manipulation with cotton buds, use of in-the-canal earphones or hearing aids, or sporadically due to the consistency of wax.

Syringing the ear with water is a frequent in-office GP procedure to attempt to relieve impaction. Take care to avoid excessive force when syringing as tympanic membrane perforation can occur. Fluid should also be roughly at body temperature to avoid the unpleasant side effect of vertigo. Mineral oil drops are readily available OTC and can help to soften cerumen to be more easily syringed. In stubborn cases, consider referral to an otolaryngologist for debridement under otomicroscopy.

Conductive hearing loss OTITIS EXTERNA

Otitis externa, also known as swimmer's ear, is commonly seen with water exposure, water trapping in the EAC, or manipulation and trauma of the EAC (for example, with cotton buds). The most common causative pathogens are *Pseudomonas aeruginosa* and *Staphylococcus aureus*. Management consists of keeping the ear dry, ear toileting, and ototopical medication (typically ciprofloxacin or ciprofloxacin-hydrocortisone preparations).¹³ These medications are usually given for a 5-7 day course. Syringing should be avoided.

In elderly patients, particularly those who have diabetes or are immunocompromised, be alert to the red flags suggestive of necrotising otitis externa (also called malignant otitis externa): disproportionate pain, granulation tissue in the EAC, or cranial neuropathies. Urgently refer patients with suspected necrotising otitis externa for specialist management. Treatment usually consists of IV antibiotics and possible surgical debridement.

TYMPANIC MEMBRANE PERFORATION

Common causes include middle-ear infection, iatrogenic (post grommet insertion), and traumatic injury (barotrauma or insertion trauma). Conductive hearing loss (CHL) occurs due to loss of the amplifying effect of the TM on the ossicular chain, as well as phase



Table 3. Causes of hearing loss

ive hearing loss		Sensorineural hearing loss
r	Middle ear	
impaction Itoma erna sis	TM perforation Tympanosclerosis Otosclerosis Ossicular chain fixation Cholesteatoma Otitis media (serous, acute, chronic suppurative)	Presbycusis Sudden sensorineural hearing loss (SSNHL) Noise-induced hearing loss Vestibular schwannoma Ototoxicity Labyrinthitis Advanced otosclerosis

diagnosis such as cholesteatoma and referred for further evaluation.

CHOLESTEATOMA

Conduct

Outer ea

Cerumen

Exostosis

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cholested

Otitis ext

Otomyco

Canal

Cholesteatoma is a locally destructive accumulation of keratinising squamous epithelium. Secretion of osteoclastic enzymes can cause erosion of middle-ear structures, leading to ossicular chain erosion, hearing loss, otorrhea and chronic infection. If left untreated, facial paralysis, vertigo. and intracranial complications can occur. Cholesteatoma can occur in the setting of chronic Eustachian tube dysfunction and TM retraction, TM perforation, squamous implantation from prior otologic surgery, or present as a congenital mass behind the TM (rare in adults).

mandatory, but despite this, cholesteatoma is highly recidivistic. Surgical treatment has traditionally involved open mastoid surgery, although mastoid-sparing transcanal endoscopic techniques are gaining traction because of improved visualisation of the middle ear.

OTOSCLEROSIS

Otosclerosis is a disease of aberrant bone turnover involving the otic cap sule. This presents as progressively worsening CHL and is bilateral in 80% of cases. The inheritance pattern of otosclerosis is autosomal dominant with incomplete penetrance and affects up to 1% of the population.13 Pathophysiologically, this results in stiffening of the stapes, thereby reducing transmission of sound into the cochlea. In advanced otosclerosis, the disease can involve the cochlea, leading to sensorineural hearing loss Suspect otosclerosis in a patient with CHL and a normal TM on otoscopy. Depending on the extent of the air bone gap (ABG), management can involve conventional hearing aids or a stapedotomy procedure to replace

the stiffened stapes with a mobile prosthesis. Stapes surgery has a risk of causing profound SNHL. Generally, the larger the ABG, the greater the chance of notable improvement postoperatively.

OTITIS MEDIA

Otitis media (OM) describes a spectrum of inflammation in the middle-ear cleft. OM can be classified acute, as in acute otitis media (AOM) and recurrent AOM, or chronic, as in chronic OM with effusion (OME), as well as chronic suppurative otitis media (CSOM) with or without cholesteatoma.¹³

Although AOM is often a disease of childhood, it can occur in adults following URTI. Refer patients with CSOM to an otolaryngologist for management, as this requires long-term follow-up, examination to rule out cholesteatoma, ear toileting, and possibly surgery.

Patients with unilateral OME on otoscopy warrant referral to otolaryngology for nasal endoscopy to rule out a nasopharyngeal mass obstructing the Eustachian tube.

	Dialat	1.04
Audiometry Legend	Right	Leit
Air Conduction	0	×
Air Conduction, Masked	•	M
Bone Conduction	۷	٧
Bone Conduction, Masked		
Sound Field		
Sound Field, Aided	Ξ	V
Comfortable Level	M	М
Uncomfortable Level	U	U

lesions that occur more laterally in the bony EAC. Management involves surgical excision through an endaural or postauricular incision.

Sensorineural hearing loss SUDDEN SENSORINEURAL HEARING LOSS

This is defined audiologically as a unilateral 30+ dB drop across three contiguous frequencies occurring within a three-day time frame (the 'rule of threes'). It is difficult to identify a definitive etiology in more than 90% of cases. Some postulated etiologies include vascular, viral, or autoimmune causes.¹⁵

Evaluate patients presenting with unilateral SSNHL for other focal neurologic deficits. Once it is confirmed as an isolated audiologic symptom, arrange urgent assessment by an otolaryngologist.

cancellation from sound waves hitting the remnant TM and round window simultaneously.

TM perforations can be dry or discharging. Initiate ototopical medications if discharging. Ciprofloxacin otic drops are most commonly prescribed and can be given for 5-7 days. Small perforations often heal spontaneously. Refer patients with non-healing, large, or marginal perforations (involving the annulus) to an otolaryngologist for consideration of repair.

Marginal perforations are at increased risk of cholesteatoma formation.¹⁴ A chronically discharging perforation that fails to resolve despite adequate ototopical therapy should raise suspicion for an alternate On otoscopy, cholesteatoma can be highly variable in appearance, ranging from a small squamous pearl to widely destructive loss of the TM with abundant keratin debris. Cholesteatoma should also be suspected in chronically discharging ears that are recalcitrant to ototopical therapy.

Refer all cases of suspected cholesteatoma. Surgical clearance is

EXOSTOSIS/OSTEOMA

Bony outgrowths of the ear canal can occasionally progress to the point of causing water trapping, recurrent otitis externa, and conductive hearing loss. Exostoses are a periosteal reaction to cold water, and commonly seen in surfers (hence the name 'surfer's ear'). These tend to occur bilaterally, present as broad-based, sessile lesions, and can extend medially, as far as abutting the TM.

Conversely, osteomas are typically unilateral, singular pedunculated Treatment consists of oral steroids for two weeks. Intratympanic injections of steroid can also be administered by an otolaryngologist, delivering high doses to the inner ear.¹⁵ A common dose of oral therapy is prednisone 1mg/kg daily, up to a maximum daily dose of 60mg. Dexamethasone (10mg/mL) is the most commonly used intratympanic steroid. Hyperbaric oxygen therapy has also been studied as a salvage therapy but is highly time-consuming

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and requires daily dives over a period of several weeks.

Untreated, only about one in three patients will have spontaneous recovery of hearing. With treatment, this increases to about 50-60%.¹⁵ Treatment must be initiated within two weeks of symptom onset, so rapid identification and referral is critical. An MRI is also usually arranged as a small percentage of SSNHL is due to vestibular schwannoma.

VESTIBULAR SCHWANNOMA

These benign tumours arise from the vestibular nerve component of the eighth cranial nerve. They occur within the internal auditory canal and cerebellopontine angle, although in rare cases they also occur within the cochlea and vestibule.

The majority of tumours are sporadic in nature, with only 5% occurring as part of a familial syndrome, neurofibromatosis type 2.¹⁶ Patients typically present with progressive unilateral hearing loss, tinnitus and vertigo. The most common audiometric finding is an asymmetric SNHL.

Poor speech discrimination scores are present in 50% of patients with vestibular schwannoma. Asymmetric SNHL should prompt referral for MRI to rule out this condition. Depending on lesion size, rate of growth and symptoms, management can range from active surveillance, to gamma knife radiosurgery, to primary surgical resection. Refer these patients to a neurotologic centre with experience in the management of vestibular schwannoma. Hearing-preserving surgery is possible.

Patients with a non-hearing ear from this condition have mixed outcomes with hearing rehabilitation, as cochlear implants show only partial success in this group.

NOISE-INDUCED HEARING LOSS

The evidence is clear that prolonged exposure to loud noise is damaging to the cochlear hair cells.¹⁷ Patients at risk of NIHL are those who have occupational exposure to noise (such as machinists and factory workers), or participate in noisy hobbies (for example, loud concerts, gun shooting).

Always ask about noise exposure, as NIHL is additive with presbycusis. Patient education regarding noise precaution is important. Audiologically, the classic finding for NIHL is a notch at 4kHz. Management involves avoidance of further noise trauma, use of appropriate hearing protection, and hearing rehabilitation via amplification if hearing loss is significant.

LABYRINTHITIS

Suspect viral labyrinthitis in patients presenting with significant vertigo and hearing loss post URTI. The nature of the vertigo is unremitting. Symptoms can last for days and up to two weeks. Treatment is primarily supportive for debilitating vertigo.





in appropriately counselling patients who experience hearing loss, regarding the natural history and manage-

Hearing aids

Hearing aids are often prescribed

Box 5. Interacting with a hearing-impaired person

GENERAL MANAGEMENT OF HEARING REHABILITATION Counselling

THE impact of hearing loss on patients is significant, affecting their mental, social, financial, and physical wellbeing. The GP is frequently the first point of contact for hearing loss and therefore plays a vital role ing the natural history and management of their condition.

Although common, hearing loss is not a normal part of ageing. Advise patients that hearing loss should not be ignored, and treatment is readily available.

Educate patients about the known link between untreated hearing loss and increased risk of dementia. Stigma regarding hearing aids is a common barrier to treatment. However, modern hearing aids are much smaller and better-disguised.

Box 5 offers advice for family and friends when interacting with a hearing-impaired patient. Box 6 lists the indications for referral for specialist assessment and audiogram. once it has been decided no further medical or surgical intervention is warranted. Conventional hearing aids are air-conduction devices that work by amplifying ambient sound which is then presented to the existing conductive hearing mechanism. Digital processing by modern hearing aids can be tailored to the hearing needs of the wearer. Devices are broadly categorised into behind-the-ear (BTE) and in-the-ear (ITE) configurations.

BEHIND-THE-EAR

These hearing aids combine a microphone, processor and battery into a unit which rests behind the pinna. As these hearing aids are larger in size, they are capable of greater

DO:

- Wait until the hearing-impaired person can see you before speaking. It is helpful to touch the person to get his or her attention
- Position yourself one metre from the person when speaking
- Speak at a normal rate
- Reduce background or competing noise
- Clue the person into any changes in the conversation topic

DON'T:

- Speak from another room or while walking away
- Speak directly into the person's ear (this distorts the message and hides visual cues)
- Shout (this may distort the message)
- Cover your mouth with your hands while speaking
- Repeat the statement if it is not understood (it is better to rephrase the statement or use different words)

Downloadable handout available at northsideaudiology.com.au¹⁸

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MEDEL.

 amplification and battery life. Their size also makes them relatively easier to handle compared with ITE designs. Because the microphone and the sound output are not immediately adjacent, BTE hearing aids also have less acoustic feedback.

IN-THE-EAR

These hearing aids offer improved cosmesis compared with their BTE counterparts as the microphone, processor and battery are combined into a unit which fits directly into the canal. Subtypes of ITE include in-the-canal (ITC) and completely-in-canal (CIC) devices. However, fitting of these devices must be precise as any leak will enable significant acoustic feedback. Furthermore, as the canal is entirely occluded, this can lead to an occlusion effect and a sensation of autophony. Their small size may also present handling difficulties for some patients.

IMPLANTABLE HEARING AIDS

Bone-anchored hearing aid Bone-anchored hearing aids (BAHA) are surgically implanted devices that transmit sound via osseous vibration (see figure 4). There are two types of BAHA: percutaneous and transcutaneous. In the percutaneous BAHA, a metal peg (abutment) is surgically implanted and osseointegrated into calvarial bone. The external BAHA attaches to the abutment and vibrates to directly stimulate the cochlea via bone conduction.

A transcutaneous BAHA involves placing an osseointegrated magnet into the calvarial bone and having the external device magnetically bound through the scalp. The transcutaneous BAHA has the advantage of not having an abutment penetrating through skin which can lead to skin irritation and complications, but suffers from reduced gain when compared to the percutaneous BAHA. This means that patients with mixed hearing loss, such as a component of mild to moderate SNHL on top of their CHL, would benefit more from the higher-powered percutaneous BAHA.

BAHAs are a good option in those with CHL, mixed hearing loss, or single-sided deafness, particularly in situations where fitting of a conventional hearing aid is difficult (see box 7). Because a BAHA directly stimulates the cochlea through vibrations of the temporal bone, it enables the patient to hear at their bone conduction threshold and bypass any conductive pathology.

In single-sided deafness, a BAHA can improve speech understanding and 360° sound awareness by transmitting sound from the deaf side via tne skull to the contralateral func tioning cochlea.

Box 6. Indications for referral

Refer all patients with concerns regarding hearing loss for an audiogram. Refer based on the results, and also in the following situations:

- Asymmetric sensorineural hearing loss
- · Conductive hearing loss • Hearing loss associated with significant otalgia, vertigo,
- or otorrhea Associated cranial neuropathies
- (such as facial palsy) · Difficulty hearing despite well-fitted hearing aids

Box 7. Criteria for boneanchored hearing aid

- Conductive hearing loss of at least 30dB air-bone gap
- Normal sensorineural hearing to moderate SNHL component in a mixed hearing loss picture (maximum 65dB SNHL)
- Congenital malformations of the outer ear, such as microtia, canal stenosis or atresia
- Surgically altered ear anatomy: large meatoplasty, prior canal wall down mastoidectomy
- Dermatitis of the EAC
- Chronically discharging ear ٠







Middle-ear implant

A middle-ear implant (see figure 5) is a surgically implanted device that works by directly stimulating the ossicular chain or round window. Indications for middle-ear implants are stringent in Australia, as many patients are adequately treated with hearing aids or cochlear implantation if severe. Typically, eligible patients for this device must have significant SNHL, but not poor enough for cochlear implantation. Furthermore, conventional hearing aids are contraindicated for medical reasons, such as pinna resection for skin cancer, severe PAGE 22 🕨

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▲PAGE 20 EAC dermatitis, or intolerable occlusion effect. There must also be no active middle-ear disease, and reasonable speech discrimination (more than 50%).¹⁹

Cochlear implant

A cochlear implant is a surgically implanted device which directly stimulates the cochlea through an electrode (see figure 6). The receiver-processor magnetically attaches to the cochlear implant transcutaneously and communicates through an induction coil to send electrical signals down the electrode. Direct stimulation of the spiral ganglion cells within the cochlea bypass the damaged cochlear duct, allowing a signal to transmit through the cochlear nerve and the auditory cortex.

Generally, cochlear implantation is reserved for patients with profound SNHL (at least 90dB PTA) and poor speech discrimination scores despite maximal hearing amplification. Besides audiologic criteria, patients must be motivated and realistic with respect to hearing outcomes.

Over time, implant criteria have been relaxed, and patients with residual hearing (that is, mild to moderate SNHL) in the low frequencies are also offered cochlear implantation. 'Soft surgery' techniques describe atraumatic insertion techniques during the time of surgery to preserve any residual hearing. Such patients can be fitted with a hybrid or electric-acoustic implant to maximise their hearing rehabilitation.

Residual low-frequency hearing is amplified acoustically as in a traditional hearing aid, while the mid- to high-frequency range is electrically stimulated through the electrode. This hearing rehabilitation technique is termed electroacoustic stimulation (EAS). Research suggests EAS

Over time, implant criteria have been relaxed, and patients with residual hearing in the low frequencies are also offered cochlear implantation.

improves word and sentence recognition as well as hearing in noise.^{20,21}

Cochlear implantation is also performed for single-sided deafness to restore a non-functional ear (for example, Meniere's disease, post-labyrinthectomy or sudden SNHL).

CASE STUDY

VICTORIA, a 66-year-old retiree, consults her GP. She is accompanied by her daughter. Victoria reports her family is increasingly frustrated with her difficulty hearing.

Victoria has not noticed a



1. Which THREE statements about age-related hearing loss are correct?

- a Age-related hearing loss is the most common cause of hearing loss in the elderly.
- b Age-related hearing loss typically begins its onset in the seventh decade of life.
- Men tend to have earlier onset and greater severity when compared with women.
- d Age-related hearing loss makes it particularly difficult to hear clearly in the presence of competing background noise.

2. Which THREE may be other otological symptoms of hearing loss?

- **a** Otalgia
- **b** Nausea
- c Tinnitus.d Otorrhoea.

3. Which THREE statements

likely to continue increasing over time due to the ageing population.

- 4. Which TWO medication classes are ototoxic?
 - a Aminoglycosides.
 - **b** Penicillins.
 - **c** Thiazide diuretics.
 - **d** Platinum-based chemotherapeutic agents.
- 5. Which THREE statements regarding the evaluation of hearing loss are correct?
 - a Speech reception threshold is the lowest intensity at which a patient can correctly hear a conversation in the presence of background noise.
 - b A Weber's test that localises to one side may imply a conductive loss on the ipsilateral side or a sensorineural loss on the contralateral ear.
 - **c** Tympanometry determines

- **b** Presbycusis.
- **c** Vestibular schwannoma.
- **d** Ototoxicity.
- 7. Which TWO statements regarding hearing loss are correct?
 - a Age-related hearing loss typically presents initially as a bilateral symmetric high-frequency conductive hearing loss.
 - **b** Vertigo and ruptured tympanic membrane are potential adverse effects of ear syringing.
- c Urgently refer patients with suspected necrotising otitis externa for specialist management.
- **d** Treatment of necrotising otitis externa usually consists of keeping the ear dry, ear toileting and ototopical medication.
- Which THREE statements regarding hearing loss are correct?
 a Small perforations of the

otitis media on otoscopy to an otolaryngologist for management.

- 9. Which TWO statements regarding hearing loss are correct?
 - a Rapid diagnosis and treatment of sudden sensorineural hearing loss improve the chance of hearing being restored.
 - **b** Noise exposure and presbycusis are additive.
 - c Vestibular schwannomas are malignant tumours arising from the vestibular nerve component of the eighth cranial nerve.
 - **d** The vertigo in viral labyrinthitis is precipitated only by a sudden change in posture, such as standing up from a seated position.
- 10. Which THREE statements regarding hearing aids are correct?
 a In-the-ear hearing aids offer

dramatic drop in her hearing. She denies any history of otalgia, otorrhea, or vertigo, although she seems to have some worsening bilateral tinnitus. She denies other risk factors including history of ototoxic drug exposure, head trauma or concussion, or excessive recreational and occupational noise exposure.

Otologic examination shows no sign of TM or middle-ear pathology. Victoria is referred for audiometry. This demonstrates a mild-to-moderate downsloping, symmetrical

SNHL in keeping with ARHL. Victoria is referred to an audiologist to consider hearing amplification.

She returns for follow-up in six months' time, again accompanied by her daughter. Her daughter reports that Mum has been using the hearing aids and notices that she seems more attentive. Victoria reports improved communication and improved mood as a result.

As Victoria is compliant with hearing amplification, a one-year follow-up is arranged.

Ten years after first being fitted with hearing aids, Victoria complains that her hearing aids are no longer effective. As a result, she feels isolated and agitated. After normal otologic examination, audiometry shows progressive SNHL, now in the severe-profound range. As she is no longer an aid-able candidate, Victoria is referred to an otolaryngologist for consideration of cochlear implantation.

CONCLUSION

THE GP should be well-versed in the differential diagnosis of hearing loss and be able to identify patients who could benefit from specialist management. Furthermore, it is important to recognise the association between untreated hearing loss and incident dementia. Hearing amplification can be achieved with a variety of devices, from hearing aids, to bone-anchored hearing aids, to cochlear implantation.

References on request from howtotreat@adg.com.au



regarding hearing loss and dementia are correct?

- a Untreated hearing loss is becoming increasingly recognised as a contributor and exacerbating factor of dementia.
- **b** Studies have demonstrated that treating ARHL can have positive effects on global cognitive function.
- c Treating ARHL can improve cognitive function in those with mild cognitive impairment and established dementia.
- **d** The prevalence of hearing loss and cognitive impairment is
- the compliance of the tympanic membrane.d Pure tone audiometry is the gold standard for evaluating hearing.
- 6. Which THREE are causes of sensorineural hearing loss?
 a Chronic suppurative otitis media.
- tympanic membrane often heal spontaneously.
- **b** Depending on the degree of impairment, otosclerosis can be managed with hearing aids or a stapedotomy.
- c Exostoses are typically bilateral, as opposed to osteomas which are generally unilateral.
 d Refer all patients with bilateral
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- improved cosmesis but may be difficult to manipulate and cause canal occlusion.
 b In single-sided deafness, a bone-anchored hearing aid can improve speech understanding and 360° sound awareness by transmitting sound from the deaf side via the skull to the contralateral functioning cochlea.
- **c** Middle-ear implants are commonly used for CHL.
- **d** A cochlear implant is the first line of management once medical and surgical options have been exhausted.



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