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Hearing loss in adults

Background

HEARING impairment threatens a person's ability to communicate, affecting their functioning in society. The condition not only affects the patient, but also their loved ones, often putting a strain on relationships because of communication difficulties.

Hearing loss has a profound impact on a patient's mental and cognitive state, as well as their quality of life.[1,2]

Mild hearing impairment affects at least 20% of Australian adults over the age of 15; this percentage increases to more than 70% for those aged over 70, of which 40% have a hearing loss of at least 45dB – around the level of conversational speech.[3] Men are more commonly affected than women.[3]

Predictions suggest that with the growing elderly population, hearing loss will be within the top 10 causes of disability in higher income countries by 2030.[4] Recent discoveries have shown links between hearing loss in the elderly and the subsequent development of dementia.[5-7] Whether this is a causal relationship or an early symptom of dementia is yet to be distinguished.

Treating hearing loss can help restore an individual's independence by restoring their ability to communicate.

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INSIDE

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Clinical assessment

A THOROUGH history and examination of the patient is required to assess for the potential cause of hearing loss. This helps to not only identify the cause of hearing loss, but also helps quantify the impact on the patient.

It is important to determine the onset and progression of the hearing loss. Hearing loss typically develops slowly over months to years. An acute onset of hearing loss overnight may represent sudden sensorineural hearing loss. This requires urgent assessment and treatment to improve the chances of recovery.

Associated otologic symptoms should be elicited — otalgia, otorrhoea, tinnitus and vertigo. Pain and discharge are most commonly associated with an infectious and inflammatory aetiology. Consider iatrogenic causes if there is a history of recent ear surgery. A thorough medication history is important to identify ototoxic agents, in particular aminoglycosides, diuretics and alkylating agents.

Risk factors, such as trauma, including noise and barotrauma, as well as exposure to heavy metals and noxious chemicals, should be sought. Environmental noise exposure could include both occupational noise, and recreational, such as shooting sports.

It is important to identify a family history of hearing loss and relevant past medical history, including previous ear infections and systemic diseases, such as diabetes mellitus, smoking and autoimmune disorders.

Finally, an understanding of the degree of impact of the hearing loss in both social and work situations allows the clinician to judge the impact on quality of life. This understanding highlights the importance of management for the patient's social network. Untreated hearing loss can slowly socially ostracise the patient and increases their risk of developing depression.[8]

Table 1. Otoscopic examination — the COMPLETE mnemonic

Feature to examine	What to look for
Colour	Describe the colour of the tympanic membrane – eg, white, red, yellow, blue or grey.
Other conditions	Look for retraction, perforation, myringosclerosis, cholesteatoma, fluid level, bubbles and thickened tympanic membrane.
Mobility	Assess the movement of tympanic membrane on Valsalva or pneumatic otoscopy.
Position	Describe the position of the tympanic membrane — eg, neutral, retracted or bulging.
Lighting	Check the light reflex on the ear drum.
Entire surface	Ensure all quadrants and margins of tympanic membrane visualised.
Translucency	Is the ear drum dull or translucent?
External auditory canal	Examine the canal for polyps, granulation, ulcers/herpetic lesions, swelling, erythema, discharge or bony outgrowths.

Begin a physical examination by asking the patient to identify their better hearing ear. An examination of hearing should include a brief cranial nerve examination with particular attention being paid to the facial nerve. Perform a basic vestibular function examination with more specific tests if the patient complains of vertigo or disequilibrium symptoms.

Perform otoscopy and remove excessive cerumen prior to assessment of hearing.

We advocate a systematic approach to otoscopy with examination of the external pinna, external auditory canal and tympanic membrane. Some causes of conductive hearing loss are apparent on otoscopy; however, the most common, such as otosclerosis, are not.

A useful mnemonic for otoscopic examination is 'COMPLETE' (see table 1).

Free field voice testing is an often-underutilised test of hearing that helps in assessing the severity of the hearing loss. It should be conducted prior to conducting tuning fork testing because the degree of hearing loss affects the interpretation of tuning fork tests.

Free field testing involves whispering combinations of three numbers (for example six-three-eight) at varying distances from slightly behind the patient's line of sight. The interpretation of varying distances and intensity is listed in table 2.

Mask the contralateral ear when the patient is being tested to prevent the patient hearing the examiner in the contralateral ear. Clinical masking is performed by either rubbing the tragal cartilage of the contralateral ear or by using a specialised instrument called a Barany box if testing at 50dB or above.

Tuning fork examination, such as a Rinne or Weber test, should be performed using either a 256Hz or 512Hz tuning fork. The tuning fork must be struck gently on the clinician's knee or elbow, roughly two-thirds of the way along the tine. This method reduces overtones or secondary notes.

Table 2. Free field voice testing

Intensity of voice	Distance from ear	Mean decibel threshold if able to hear	Ideal method of masking
Whisper	60cm — arm's length	15dB	Tragal rubbing
	15cm	35dB	
Conversation	60cm — arm's length	50dB	Tragal rubbing
	15cm	55dB	
Loud	60cm — arm's length	75dB	Difficult to adequately mask without Barany box
	15cm	90dB	

Table 3. Summary of tuning fork examination

	Weber test	Rinne test
Tuning fork placement	Central	Behind ear on the mastoid and in front of the ear
Normal hearing	Noise is heard centrally	Air conduction is better than bone conduction
Sensorineural hearing loss	Noise is heard better in unaffected ear	Air conduction is better than bone conduction on affected side
Conductive hearing loss	Noise is heard better in affected ear	Bone conduction is better than air conduction on affected side

A Weber test is performed by placing the base of a vibrating tuning fork on the vertex of the scalp. The patient is then asked whether the sound is heard and if so, whether it is midline or louder in a particular ear. There is likely a conductive hearing loss if the sound lateralises to the worse hearing ear and a sensorineural hearing loss if the sound lateralises to the better hearing ear. Because the Weber test detects differences between air and bone conduction in one ear compared with the other, it cannot identify individuals with bilateral hearing loss and mixed hearing loss.

A Rinne test is performed by assessing bone and air conduction. Bone conduction is assessed by placing a vibrating tuning fork behind the ear on bone. Air conduction is assessed by placing the fork, with the tines of the fork running parallel to the ear, roughly 3cm from the external auditory canal.

Initially, the patient's bone conduction is assessed and while still vibrating, the fork is quickly moved to in front of the ear to assess air conduction. The patient is then asked if the sound was louder behind or in front of the ear. A Rinne test is said to be positive, or normal, when air conduction is better than bone conduction; while this is normal, it could possibly indicate sensorineural hearing loss. However, if bone conduction is better than air conduction, that is a negative Rinne test, this could represent a conductive hearing loss in that ear.

Common causes

HEARING loss can be conductive, sensorineural or a mixed. Conductive hearing loss involves a disruption of the transmission of sound waves from the external environment through to the stapes footplate. Sensorineural hearing loss involves some component of the auditory pathway from the inner ear, through the cochlear nerve, brain stem and to the auditory cortex.

Conductive hearing loss

Ear wax

Ear wax obstructing the external auditory canal is among the most common presentations of conductive hearing loss to GPs. Wax removal is the most commonly performed ENT procedure in general practice.[9] It is more common in men and the elderly.[10, 11]

Ear wax is typically removed when associated with hearing loss, otologic symptoms or is obscuring a diagnostic view of the tympanic membrane. Manual removal with direct microscopic visualisation is ideal. However, this may prove impractical in primary care. Recent guidelines are available on the use of ear irrigation in primary care — if wax is impacted, olive oil or wax softeners can be used prior to irrigation.[12] Irrigation is not without complications as it can cause vertigo, tympanic membrane perforation and otitis externa.

A history of previous ear surgery or significant ear disease is a contraindication to irrigation, and it is better to refer these patients to specialists for review and manual removal of wax using a microscope.

Figure 1. Exostoses seen on otoscopic examination. Multiple broad-based bony lesions seen within the external auditory canal.

Bony outgrowths of the external auditory canal

These may be noticed on otoscopy (see figure 1). These can either be osteomas, which are often pedunculated, solitary, unilateral lesions, or they can be exostoses, which are multiple, bilateral, broad-based lesions associated with cold water exposure. Exostoses occur in 70-80% of surfers and the degree of obstruction increases with the frequency and duration of surfing.

Mild to moderate obstruction often causes water trapping which is either avoided with ear plugs or treated with alcohol based drops (Aquaear) that evaporate the water. When the exostoses obstruction becomes severe, conductive hearing loss develops.[13]

Refer to a specialist for review and consideration of surgery if there is conductive hearing loss associated with the presence of large exostoses, symptoms of water trapping or recurrent otitis externa.

Otitis externa

This infection of the external auditory canal can lead to significant swelling which can cause a subacute onset of conductive hearing loss. Bacterial infection is often preceded by water exposure or a history of manipulation of the skin of the ear canal, and is characterised by pain, itch and discharge.

It is best managed with dry ear precautions and topical ciprofloxacin ear drops. However, if the canal swelling has completely obstructed the canal, a temporary wick may be required. If there is granulation tissue, failure to respond to topical therapy within two weeks of treatment or if the pain is out of proportion with clinical findings, then an urgent specialist review may be required to assess for skull base osteomyelitis (also known as malignant or necrotising otitis externa).

Tympanic membrane perforation

Assessment of the tympanic membrane may reveal pathology that can contribute to conductive hearing loss. A tympanic membrane perforation affects the mechanics of sound transmission through the middle ear into the cochlea. A perforation may be caused by either infection or trauma, including barotrauma. It is seen on clinical examination and is classified depending on the size and position on the perforation (see figure 2).

Tympanic membrane perforations involving the annulus or margins of the tympanic membrane, as well as symptomatic or non-healing perforations, should be referred to a specialist. Patients should be warned to keep their ear dry and avoid any further trauma,

for example, using ear buds or syringing.

Fluid in the middle ear

This results in reduced compliance and movement of the tympanic membrane and ossicular chain (see figure 3). While acute otitis media and otitis media with effusion are more common in children, these can also occur in adults. In adults, these conditions are often associated with a coryzal infection or allergic rhinitis. If an adult has a unilateral middle ear effusion without pre-existing nasal symptoms, one must be suspicious for a nasopharyngeal mass lesion compressing the eustachian tube. A specialist referral is indicated if the effusion is not resolved within six weeks and causing symptoms despite regular use of topical nasal steroid.

Otosclerosis

Otosclerosis presents with progressive hearing loss, usually in women aged between 20 and 40. The hearing loss can be conductive or sensorineural, depending on the extent of the disease. The disease process is unique to the human otic capsule, and involves osteoclastic activity and osteoblastic deposition. This process begins at the front of the stapes footplate and can extend to involve the whole stapes and the tendons around it, causing fixation. Occasionally only the cochlea is involved, and this is termed cochlear otosclerosis.

Patients with otosclerosis present with progressive conductive hearing loss, which is bilateral in 70% of cases. There is often a family history of hearing loss as otosclerosis is inherited as an autosomal dominant condition with variable penetrance. The tympanic membrane appears normal and the tympanogram is also normal.

Acoustic reflex testing is performed by an audiologist. This is a sensitive way of measuring movement of the stapes, which is absent in otosclerosis. A suspicion of otosclerosis should prompt a specialist referral for further assessment, imaging and potential surgical correction.

Cholesteatoma

Cholesteatoma is the presence of proliferating squamous epithelium within the middle ear cleft. In adults, cholesteatoma most commonly presents with conductive hearing loss in a discharging ear.

The clinical examination is usually diagnostic, with a retraction pocket seen in the attic of the tympanic membrane with keratin debris (see figure 4). Cholesteatoma leads to chronic infection and inflammation of the middle ear, which stimulates osteoclastic activity, resulting in erosion of the ossicular chain, as well as other bony structures in the middle ear. If left untreated, it can erode into the inner ear structures or skull base, leading to permanent hearing loss, facial nerve palsy, disequilibrium, permanent neurological disability and life-threatening intracerebral infections.

A diagnosis of cholesteatoma warrants a specialist referral for consideration of further imaging with a CT of the petrous temporal bones, and surgical removal.

Figure 2. An anteroinferior perforation of the tympanic membrane with posterior myringosclerosis.

Figure 3. Yellow serous fluid seen behind the tympanic membrane.

Figure 4. Cholesteatoma is demonstrated by the presence of squamous debris and retraction of the postero-superior quadrant of the tympanic membrane.

Figure 5. MRI findings of a large, left-sided cerebellopontine angle mass extending into the internal auditory meatus — representative of a vestibular schwannoma.

Sensorineural hearing loss

Presbycusis

Presbycusis, translated as "ageing hearing", is the most common sensory deficit in the elderly. It is a general term used to describe hearing loss in the elderly and as such, has a multifactorial aetiology. It is caused by a combination of the physiological deterioration of the sensory, neural and central components of the hearing pathway with slower central processing of auditory information.

The condition has a significant impact on a patient's quality of life and psychosocial situation. This type of hearing loss has been linked to depression and dementia, causing social isolation and loss of self-esteem.[14]

Presbycusis tends to run in families and has a genetic component. Noise-related hearing loss, smoking, chronic medical conditions and the medications used to treat them are also thought to contribute to this process.

The patient has difficulty in hearing conversations, particularly in loud environments such as social situations. Relatives and friends may notice the problem before the patient does. The complaint is typically a loss of clarity of words and there is often an associated tinnitus. Vowel identification can prove difficult as the disease progresses, with patients complaining they confuse words that sound similar.

The physical examination is normal. The audiogram reveals a symmetrical down-sloping high-frequency sensorineural hearing loss.

No treatment currently exists to restore the patient's lost hearing. Certain lifestyle changes, explained below, are suggested for patients with hearing loss, and for their relatives and friends. Consider amplification when a patient's hearing thresholds drop below 40dB on the audiogram, and also in people with lesser hearing loss who would benefit socially from amplification.[14]

Hearing aid use in elderly individuals with hearing loss has been shown to be associated with reduced depressive symptoms, improved quality of life and reduced caregiver burden.[15] Consider specialist referral when hearing aids no longer meet the requirements of the patient with severe to profound sensorineural hearing loss in both ears.

A patient is a candidate for cochlear implantation when they understand less than 60% of sentences with well-fitted hearing aids.

Noise-induced hearing loss

Noise-induced hearing loss can be either temporary or permanent. The hearing loss results from mechanical and metabolic damage to the sensitive hair cells of the inner ear. It can result from occupational noise exposure, hobbies such as power tools, shooting or music concerts.

The intensity, frequency and duration of the sound are the three important characteristics in determining the nature of hearing loss. Modifiable risk factors that exacerbate noise-induced hearing loss include non-compliance with ear protection, smoking, poor diet and lack of exercise.[16] The hearing loss can be symmetrical or unilateral depending on the type of exposure. For example, the hearing loss associated with shooting is worse on the side of the trigger hand, but exposure in the work place is symmetrical. The audiogram reveals a symmetrical sensorineural hearing loss with a notch at the 4kHz frequency.

The NSW Work Health and Safety regulations recommend a standard for workplace exposure where noise should not exceed 85dB for eight hours or 140dB at any time. Ear protection must be provided for employees under these circumstances and penalties exist where it is not provided. Ear plugs provide approximately 15dB of protection and over-the-ear muffs provide 30dB of protection.

Sudden sensorineural hearing loss

Sudden sensorineural hearing loss is a presenting complaint that is defined as a loss of at least 30dB at three consecutive frequencies within three days.[17] Patients often notice unilateral hearing loss on awakening with a sensation of aural fullness in the affected ear. Tinnitus and vertigo can also be present. There are numerous potential causes for this presentation, however, no cause is found in the majority of patients.

The patient should be questioned and examined thoroughly as described above to confirm a sensorineural hearing loss, and to determine a potential cause. The use of steroids in this hearing loss has been a point of contention recently, with evidence suggesting equivocal results, if not limited benefit, in certain patient populations.[17]

In the absence of a clear cause and contraindications, we recommend the patient be started on a daily dose of oral prednisone (1mg/kg up to 60mg). Should this fail, intratympanic steroids may be considered. An urgent audiogram and referral for specialist review should be made. A specialist-ordered MRI will rule out brain stem or internal auditory meatus lesions. Indicators of poor prognosis include severe hearing loss (more than 90dB), a down-sloping or flat audiogram, presence of vertigo and where the patient is aged under 15 or over 60.

Vestibular schwannoma

Vestibular schwannoma typically presents with gradual-onset asymmetrical sensorineural hearing loss. The condition may also present with sudden sensorineural hearing loss, with tinnitus often accompanying this presentation. Patients can also have disequilibrium symptoms, facial paraesthesias or weakness.[18]

A fine-slice MRI of the internal auditory meatus with gadolinium contrast is the investigation of choice for both diagnosis and monitoring of internal auditory canal tumours.[19] It is important to note that a CT scan or standard MRI of the head may not detect these tumours. Depending on the size of the tumour, rate of growth and patient characteristics, treatment may consist of observation, with MRI monitoring, radiotherapy or surgical removal. Figure 5 is an example of left-sided vestibular schwannoma.

Other

In addition to the above-mentioned conditions, many medications can result in hearing loss. Predisposing factors for ototoxicity include renal dysfunction, concurrent sepsis and fever.

A list of common medications appears in the box.

Common medications associated with ototoxicity

- Aminoglycosides: gentamicin and amikacin
- Platinum based chemotherapy: cisplatin and carboplatin
- Loop diuretics: frusemide and bumetanide
- Quinines: chloroquine and hydroxychloroquine

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Investigations

Audiometry

ALL patients with new complaints of hearing loss should have an audiogram to determine the presence of hearing loss, classify the type and quantify the degree of loss. Audiometry allows for testing of bone and air thresholds in each ear at various frequencies (or tones, hence, pure tone audiometry).

Test results are recorded using a measurement called decibels (dB for short) — a standardised biological scale of human hearing based on what a young adult would normally hear. A normal hearing individual would be expected to have a flat audiogram with the mean level 0-20dB.

Tympanograms measure the compliance of the tympanic membrane in response to changes in pressures and sound. The shape of the tympanogram is interpreted as a type A, B or C (see figure 7).

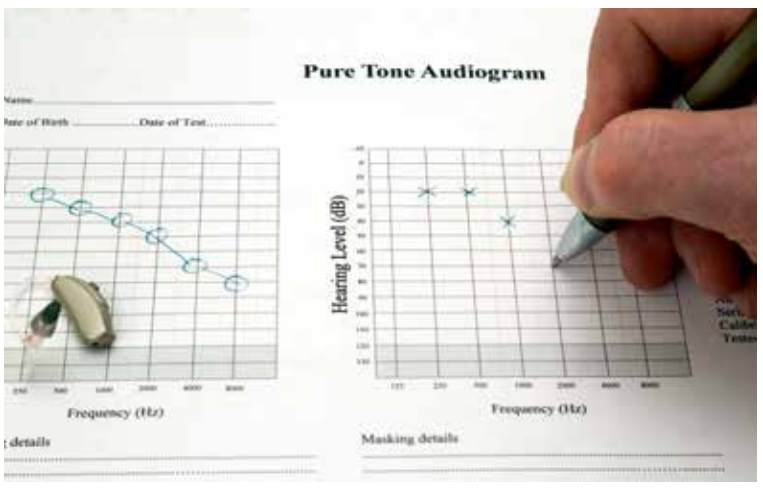
Type A tympanograms have the peak pressure within the normal range. Type C tympanograms have the peak pressure more negative than the normal range, implying a negative middle ear pressure. A type C tympanogram is seen in eustachian tube dysfunction and otitis media with effusion. A type B tympanogram has no obvious peak and could be representative of otitis media with effusion (with a small volume) or perforation (with a large volume).

Speech testing consists of various tests used to not only determine if the listener can hear and repeat words, but also if they can recognise speech. Speech discrimination testing helps in diagnosis, assesses suitability for surgical intervention, monitors progress after intervention and provides information on how the patient is able to communicate.

Speech discrimination is often maintained in conductive hearing loss, but is reduced in cochlear pathology. In retrocochlear pathology, lesions that are central (medial or proximal) when compared with the cochlear (for example, vestibular schwannoma), speech discrimination is markedly reduced, sometimes even in the presence of normal audiometry thresholds.

Interpreting an audiogram

1. Are the thresholds symmetrical in both ears (within 10dB of each other)?
2. Is there a conductive hearing loss? This is demonstrated by an air-bone gap of greater than 10dB, usually in the lower frequencies.
3. Is there sensorineural hearing loss? This is demonstrated by worse than normal (>25dB loss) hearing, which more commonly affects the higher frequencies.
4. Is the hearing impairment mixed? Is there an air-bone gap of more than 10dB with abnormal thresholds for bone conduction?
5. How severe is the hearing impairment? See figure 6 for threshold values.
6. Does the hearing impairment have a pattern? Is it flat, down-sloping, up-sloping or are there notches? See figure 6 for examples.



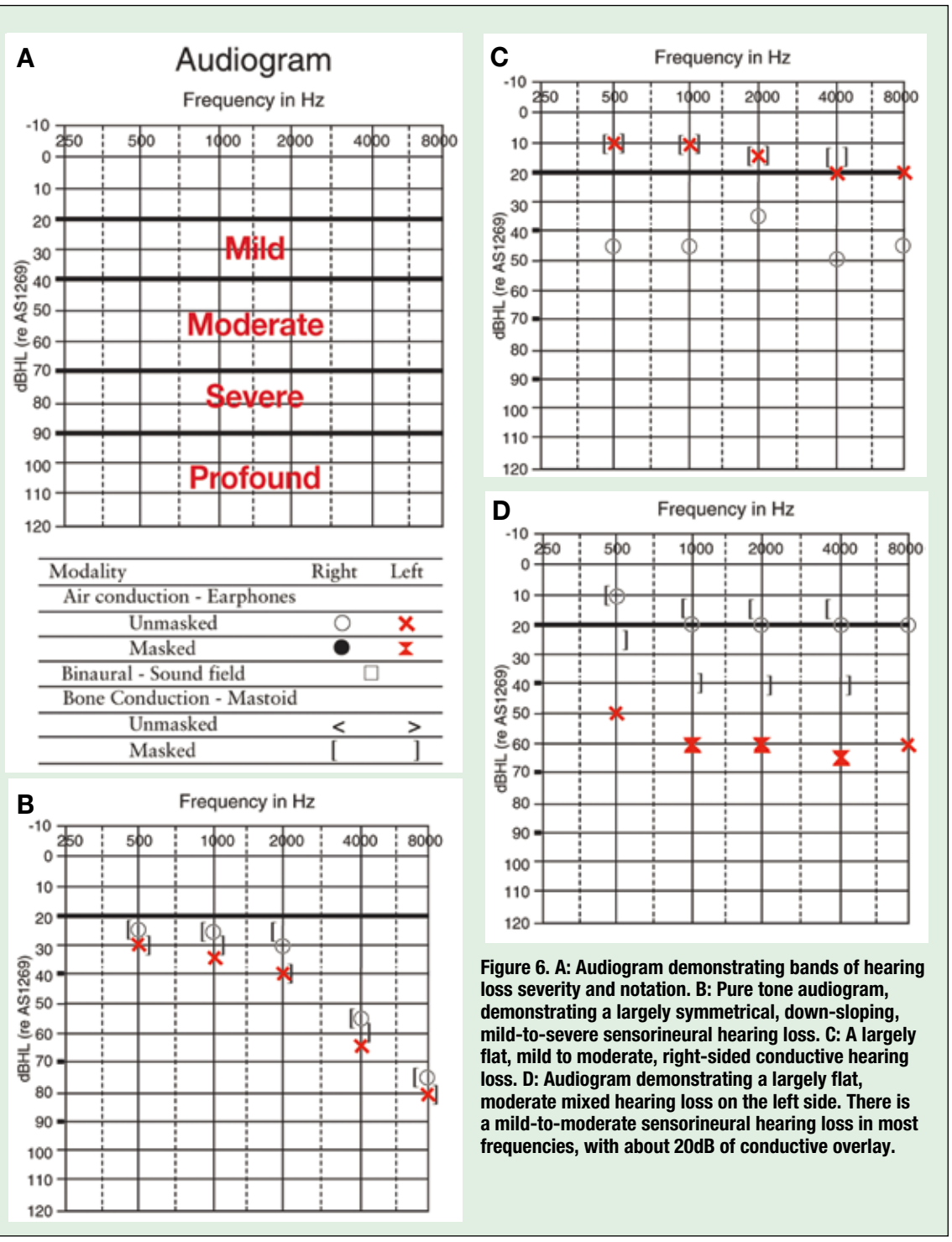


Figure 6. A: Audiogram demonstrating bands of hearing loss severity and notation. B: Pure tone audiogram, demonstrating a largely symmetrical, down-sloping, mild-to-severe sensorineural hearing loss. C: A largely flat, mild to moderate, right-sided conductive hearing loss. D: Audiogram demonstrating a largely flat, moderate mixed hearing loss on the left side. There is a mild-to-moderate sensorineural hearing loss in most frequencies, with about 20dB of conductive overlay.

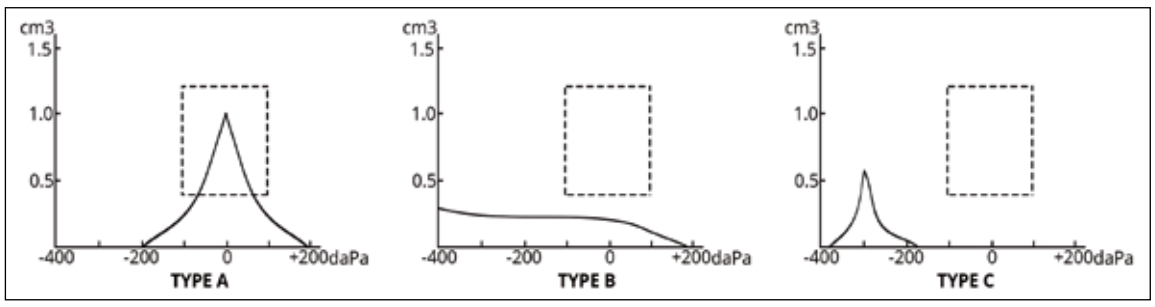


Figure 7. Normal (type A) tympanogram. Flat (type B) tympanogram indicating middle-ear effusion. Left-shifted (type C) tympanogram, indicating eustachian tube dysfunction.

Management

Counselling

HEARING loss is a frightening prospect for patients and relatives; it affects their ability to communicate with loved ones and interact safely within their environment. The GP is often the first point of contact for a patient or relative who is having difficulty with their hearing. A GP can provide advice (see box) to the patient and relatives to help adjust to hearing loss.

Referral to ENT surgeon

Consider referral to an ENT surgeon if any of the following concerning factors are present:

- Asymmetrical hearing loss — conductive or sensorineural.
- Conductive hearing loss — even if symmetrical.
- Sensorineural hearing loss that doesn't follow typical pattern of presbycusis (see above).
- Hearing loss associated with disequilibrium, vertigo, otalgia, otorrhoea or cranial nerve palsy.

Hearing aids

Consider hearing aids once medical and surgical management options have been tried. There have been great developments and improvements in hearing aid design over the past few years. Component miniaturisation has allowed smaller hearing aid design with additional features.

Modern air conduction hearing aids use digital processing, where acoustic signals are converted to digital signals, which then undergo various amplifications and are then converted back to acoustic signals. This has allowed frequency-shaping personalisation with reduced acoustic feedback and noise so patients hear more of what they need to and less of what they don't.

Broadly speaking, there are two main categories of air conduction hearing aids used in Australia: the behind-the-ear (BTE) and in-the-ear (ITE) aid.

Behind-the-ear

BTE hearing aids rest behind the pinna and are connected to a speaker that sits in the external auditory canal. The external component consists of the controls, battery, microphone and amplifier unit. These units are more powerful with the lowest potential for acoustic feedback, which is where there is a feedback loop created between the microphone and the speaker. There are also ventilation ports with BTE aids, allowing the transmission of natural, low-frequency sound and aeration of the external auditory canal, decreasing the chance of infection. BTE aids are more durable and more comfortable to wear and fit (see figure 8).

In-the-ear

In contrast to BTE hearing aids, ITE aids are a single case that contains all of the components required to amplify sound. These can rest either in the outer ear, in-the-canal (ITC) or completely-in-the-canal (CIC). These vary in how far into the canal they rest, and this can be advantageous for cosmetic and functional purposes. The main disadvantage of these systems is that they totally block the ear canal, causing moisture and an occlusion effect in which there is a perceived autophony.

There is also a loss of normal low-frequency sound, which is able to pass through ventilation ports in BTE aids, sometimes causing hearing loss (see figure 9).

Bone conduction hearing aids

Bone conduction hearing aids

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GP advice for family and friends of deaf patients

DO:

- Wait until the hearing-impaired person can see you before speaking. Touch is helpful to get their attention
- Position yourself close to the person when speaking
- Speak at a normal rate and try to enunciate clearly
- Reduce background and competing noise
- Clue the person into any changes in the conversation topic
- Rephrase the question if not understood

DON'T:

- Speak from another room or while walking away
- Speak directly into the person's ear (this distorts the message and hides visual clues)
- 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)

Source: Norwest ENT group

are devices where a microphone receives sound and processors convert the sound into mechanical energy, which is then transmitted to the patient via an oscillator. They are used in conductive and missed hearing loss.

The oscillator is placed with contact with the mastoid with firm pressure — this pressure can be applied by a headband or eyeglasses. This bypasses the air conduction pathway of hearing and the sound energy passes straight into the cochlea via bone (see figure 10).

Bone anchored hearing aids are a type of bone conduction hearing aids. They differ from the abovementioned bone conduction hearing aids in that they are surgically integrated into bone. A surgical drill is used to insert the implantable titanium screw, which sits flush on the mastoid bone behind the ear. The remainder of the implant is then screwed onto this and sits slightly elevated under the scalp. Once the implant is inserted, an external microphone and processor unit is then used to receive sound.

Figure 8. A behind-the-ear hearing aid.
Image reproduced with permission GN Resound.

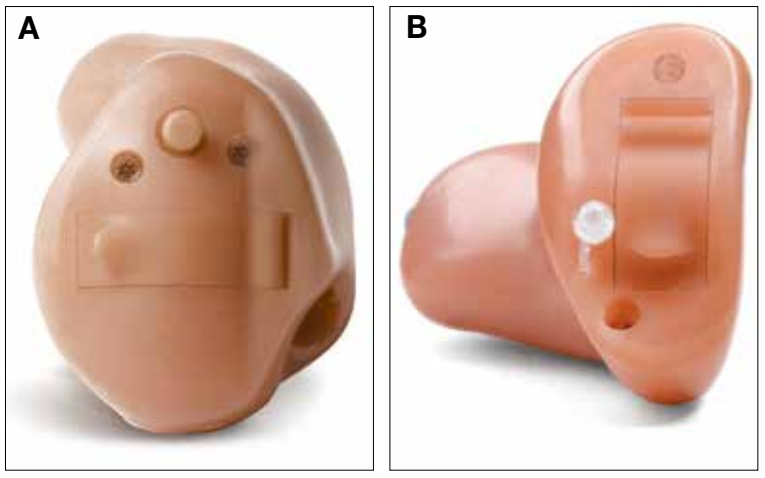

Figure 9a and b. A completely-in-canal and in-the-canal hearing aids.
Image reproduced with permission GN Resound.

When to consider a bone conduction hearing aid

- Patients with a conductive air-bone gap greater than 30dB with reasonable sensorineural thresholds
- Chronically discharging ears not responding to medical and/or surgical therapy
- Dermatological conditions of the external auditory canal that is exacerbated by traditional hearing aids
- Patients unable to tolerate an air conduction hearing aid for anatomical reasons — previous canal wall down, mastoidectomy or meatoplasty
- Patients with otosclerosis, tympanosclerosis, canal atresia unsuitable for corrective surgery

Bone conduction hearing aids are useful in patients for whom conventional air-conduction hearing aids are not suitable, as listed in the box.

Cochlear implants

Cochlear implants are surgically inserted into the cochlear and are designed to electrically stimulate the cochlear nerve fibres, thereby providing hearing. The implants consist of an external microphone and processor unit, with transmission into an internal implant with a receiver and electrode.

Cochlear implants are inserted using a trans-mastoid approach, similar to a mastoidectomy; a post-auricular incision is made and the mastoid bone is drilled to allow access to the round window. A small hole is made adjacent to the round window and the electrode is then inserted into the inner ear. With the electrode in place, the remainder of the implant is tunnelled and secured under the subcutaneous tissues. The implant is tested while the patient is still anaesthetised. A formal switch-on process takes place at least a fortnight after the surgery.

Cochlear implants have an expanding list of indications in sensorineural hearing loss affecting both children and adults. In general, if the patient has reduced sentence recognition with moderate to profound hearing loss in both ears or profound hearing loss in one ear with no improvement with hearing aids, they can be considered for implantation.

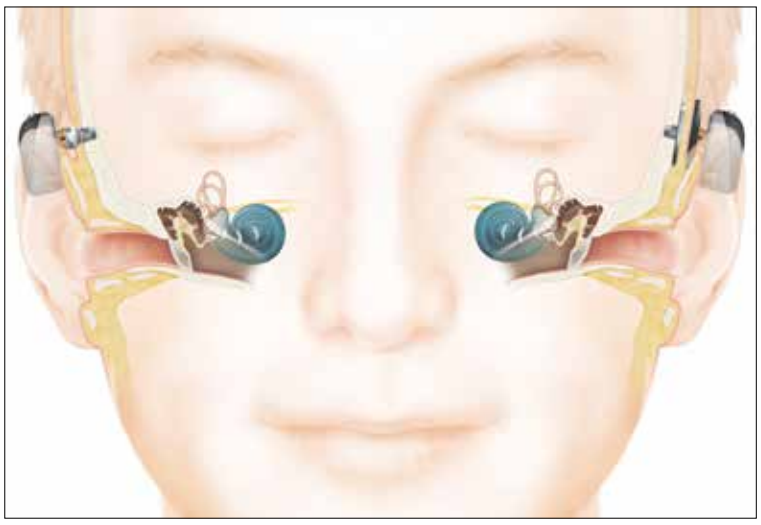

Figure 10. This demonstrates a bone anchored hearing aid and the transmission of vibrations though the external auditory canal bone into the cochlear.
Image reproduced with permission from Cochlear.

Figure 11a. Demonstrating Cochlear implant apparatus with where it is inserted in relation to receiver.

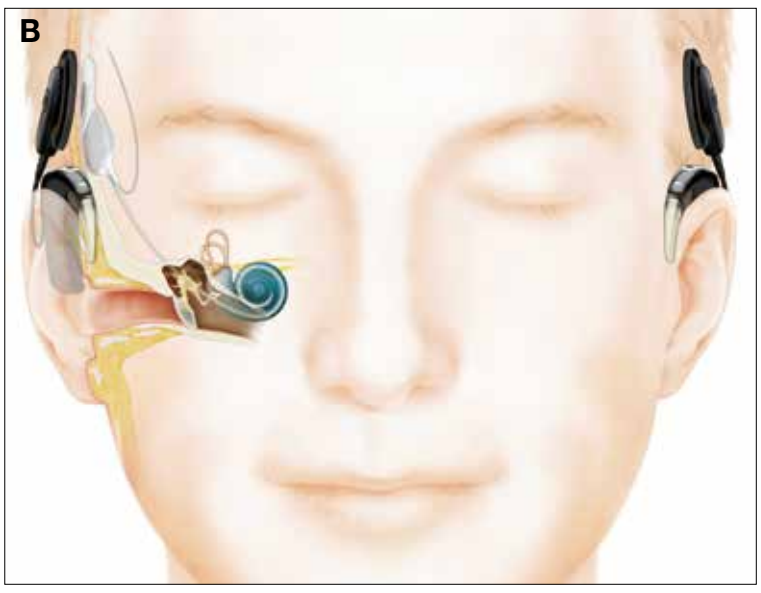

Figure 11b. Earhook in situ.
Both images reproduced with permission from Cochlear.

Case studies

Case study one

GEORGE, aged 67, presents to his GP with a unilateral right-sided hearing loss. He noticed the hearing loss on awakening and reports a sense of fullness on the ipsilateral side. There is no history of otalgia, otorrhoea, vertigo, disequilibrium, cranial nerve weakness, trauma, recent infections or prior issues with his hearing. George, a retired pharmacist, is otherwise well.

On examination, both external auditory canals are normal, with mobile, intact tympanic membranes on each side. Free-field testing suggests at least a moderate hearing loss on the right side. Tuning fork examination reveals a Weber's test which lateralises to the contralateral side, and the Rinne's test reveals air conduction is better than bone conduction on both sides. There is no clear identifiable cause for the hearing loss and no contraindications to steroid treatment.

George consents to, and is started on, a once-daily dose of 60mg of prednisone for two weeks, and referred for an urgent audiogram and ENT review. An audiogram the next day reveals a 70-80dB sensorineural hearing loss on the affected side, with a down-sloping high-frequency hearing loss on the unaffected side (see audiogram).

After a week on prednisone,

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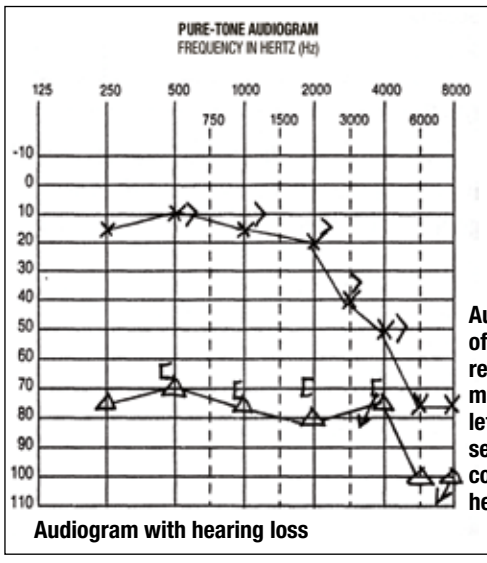
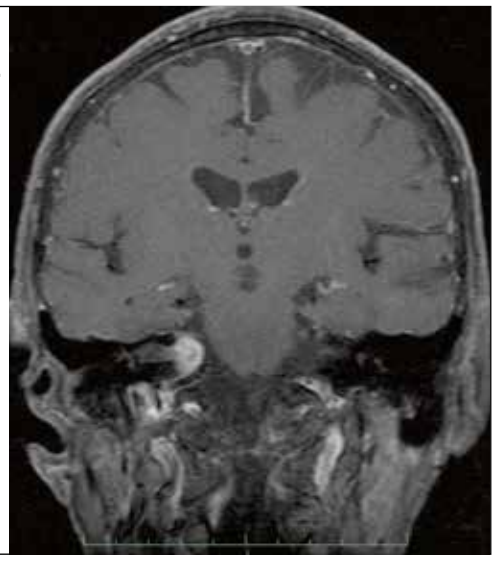


Audiogram with hearing loss

Audiogram of patient revealing right moderate and left moderately severe conductive hearing loss.



MRI scan revealing a right vestibular schwannoma.

from page 24

George is reassessed by an ENT specialist. The hearing loss has started to resolve and free-field testing reveals a now mild sensorineural hearing loss on the same side. An MRI internal auditory meatus is organised.

The following week, George's ENT assessment reveals now normal hearing on the right side. Despite this, the MRI is conducted and reveals a right cerebellopontine angle mass consistent with a vestibular schwannoma.

The management options, including surgical excision, radiotherapy or conservative 'watch and wait', are discussed. George elects to have a repeat scan in six months and hold off definitive management in the interim.

This case illustrates the importance of ENT referral and appropriate investigation with an MRI, despite recovery of hearing loss with steroid therapy.

Case study two

Andrea, a 34-year-old solicitor, presents with progressive bilateral hearing loss, which has been affecting her ability to communicate with clients. She says she has previously had issues with cerumen impaction in both ears and thinks the hearing loss is due to accumulation of cerumen. She reports that her hearing loss is worse on the left.

Andrea feels her hearing got worse when she gave birth to her first child two years ago. There is no history of otalgia, otorrhoea, vertigo, disequilibrium, cranial nerve weakness, trauma, recent infections or prior issues with her hearing.

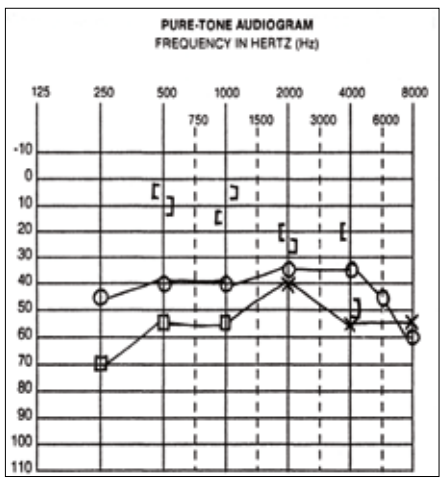
She has no other medical history, although her mother also had hearing loss from a young age and wore hearing aids for most of her life.

On examination, both external auditory canals are clear of cerumen and both tympanic membranes appear unremarkable, are intact and mobile on pneumatic otoscopy. Free-field testing reveals at least moderate hearing loss on both sides, with slightly worse hearing on the left.

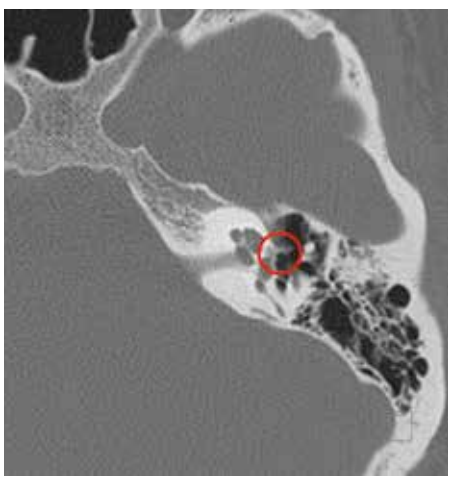
Tuning fork examination revealed a Weber's test, which lateralised to the left side and a reversed Rinne's tests on both sides (bone conduction was better and air conduction). Andrea is referred for an audiogram and to an ENT surgeon.

The audiogram reveals bilateral moderate-severe conductive hearing loss, with larger air bone gaps on the left side. The ENT surgeon orders a fine cut CT scan of the petrous temporal bones, which reveals otosclerosis.

Andrea subsequently undergoes an endoscopic laser-assisted stapedectomy on the left side, with good closure of the air bone gap (note: a video of the procedure is available in online resources). The patient is waiting to have the same surgery on her right ear.



Audiogram with bilateral conductive hearing loss.



Axial CT scan of the left petrous temporal bone revealing dense otosclerotic bone around the oval window indicative of otosclerosis.

Online resources

NSW Work Health and Safety regulations
http://bit.ly/2eDCHKO

Norwest ENT group GP resources
http://bit.ly/2fqwOQ5

American Academy of Otolaryngology Head and Neck Surgery
Clinical practice guidelines on cerumen impaction
http://bit.ly/2etzvye

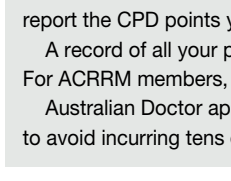
Insertion of a bone anchored hearing aid
http://bit.ly/2fphsiz

Cochlear implantation
http://bit.ly/2etZTZt

Endoscopic laser-assisted stapedectomy
http://bit.ly/2f3SBzm

References

Available on request from howtotreat@adg.com.au



How to Treat Quiz

Hearing loss in adults — 3 February 2017

GO ONLINE TO COMPLETE THE QUIZ

www.australiandoctor.com.au/education/how-to-treat

1. Which TWO statements regarding hearing loss are correct?
a) Mild hearing impairment affects at least 20% of Australian adults over the age of 15.
b) Mild hearing impairment affects 90% of those aged over 70.
c) Men are more commonly affected by hearing loss than women.
d) Recent research has shown hearing loss as a definitive predictor of dementia.

2. Which THREE of the following regarding the clinical assessment of hearing loss are correct?
a) Hearing loss typically develops slowly over months to years.
b) Symptoms associated with hearing loss may include otalgia, otorrhoea, tinnitus and vertigo.
c) Pain and discharge are most commonly associated with a neural aetiology.
d) Aminoglycosides, diuretics and alkylating agents are ototoxic.

3. Which TWO statements regarding examination are correct?
a) Begin a physical examination with a hearing test with an audiologist.
b) An examination of hearing should include a brief cranial nerve examination with particular attention being paid to the facial nerve.
c) Otosclerosis, one of the most common causes of conductive hearing loss, is readily apparent on otoscopy.
d) Perform a basic vestibular function examination with more specific tests performed if the patient complains of vertigo or disequilibrium symptoms.

4. Which THREE statements regarding hearing testing are correct?
a) Tuning fork examination, such as Rinne or Weber test, should be performed using either a 256Hz or 512Hz tuning fork.
b) The Weber test is the most sensitive for identifying individuals with bilateral hearing loss and mixed hearing loss.
c) A Weber test is performed by placing the base of a vibrating tuning fork on the vertex of the scalp.
d) A Rinne test is performed by assessing bone and air conduction.

5. Which TWO statements regarding the common causes of hearing loss are correct?
a) Hearing loss can be conductive, sensorineural or mixed.
b) Conductive hearing loss involves a disruption of the transmission of sound waves from the external environment through to the malleus footplate.
c) Earwax is an uncommon cause of conductive hearing loss.
d) Sensorineural hearing loss involves some component of the auditory pathway, from the inner ear, through the cochlear nerve, brain stem and to the auditory cortex.

6. Which THREE statements regarding conductive hearing loss are correct?
a) Irrigation to remove earwax is a simple, complication-free, office-based procedure.
b) Earwax removal is the most commonly performed ENT procedure in general practice.
c) A history of previous ear surgery or significant ear disease is a contraindication to irrigation.
d) Exostoses are common in surfers, and the degree of obstruction increases with the frequency and duration of surfing.

7. Which TWO statements regarding conductive hearing loss are correct?
a) All tympanic membrane perforations will heal with conservative management and specialist referral is not required.
b) In otitis externa, bacterial infection is often preceded by water exposure or a history of manipulation of the skin of the ear canal.
c) A unilateral middle ear effusion in an adult without pre-existing nasal symptoms requires a six-week course of nasal steroids for decongestion.
d) Patients with otosclerosis present with progressive conductive hearing loss, which is bilateral in 70% of cases.

8. Which THREE statements regarding sensorineural hearing loss are correct?
a) Presbycusis is the most common sensory deficit in the elderly.
b) Patients with presbycusis have difficulty in hearing conversations, particularly in loud environments, such as social situations.
c) Noise-induced hearing loss results from mechanical and metabolic damage to the sensitive hair cells of the inner ear.
d) The cause of sudden sensorineural hearing loss is easily determined on thorough history and examination.

9. Which TWO statements regarding investigation of hearing loss are correct regarding?
a) A normal hearing individual would be expected to have a flat audiogram with the mean level 20-40dB.
b) A type C tympanogram is seen tympanic membrane perforation.
c) Speech testing consists of various tests used to determine if the listener can hear and repeat words, and if they can recognise speech.
d) Audiometry allows for testing of bone and air thresholds in each ear at various frequencies.

10. Which THREE statements regarding the management of hearing loss are correct?
a) Refer to an ENT specialist in the presence of hearing loss associated with disequilibrium, vertigo, otalgia, otorrhoea or cranial nerve palsy.
b) There are two main categories of air conduction hearing aids used in Australia: the behind-the-ear aid and in-the-ear aid.
c) The main disadvantage of the behind-the-ear systems is that they totally block the ear canal causing a moist ear canal and an occlusion effect in which there is a perceived autophony.
d) Cochlear implants are surgically inserted into the cochlear and are designed to electrically stimulate the cochlear nerve fibres, thereby providing hearing.

NEW RULES

IN the past, when you completed a How to Treat quiz, the CPD points you earned were uploaded every six weeks to the RACGP website. However, due to the implementation of a new notification fee, *Australian Doctor* will now only upload your points to the RACGP, on request, at the end of this triennium (31 December 2019).

You will still be able to download a certificate of completion at any time after successful completing the online quiz. You will also be prompted to self-report the CPD points you have earned to either college at any time at no cost.

A record of all your points earned through How to Treat quizzes will be available under 'achievements' in the How to Treat section of our website. For ACRRM members, PDP points will be uploaded to ACRRM quarterly.

Australian Doctor apologises for any inconvenience but as How to Treat is free, independent and receives no sponsorship, we need to make this change to avoid incurring tens of thousands of dollars in RACGP fees.

Australian Doctor Education

NEXT WEEK'S HOW TO TREAT

Pulmonary rehabilitation and oxygen therapy. The authors are **Dr Sarah Gleeson**, Sunshine Coast, Queensland, and **Dr Claire Ellender,** Brisbane, Queensland.

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