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NEED TO KNOW

Earlier detection of hearing loss and subsequent intervention improves outcomes, particularly in younger children, as hearing loss affects language and cognitive development, behaviour, literacy and social skills.

Perform an otoscopic examination using the 'COMPLETE' mnemonic.

Pneumatic otoscopy is a simple and effective tool for assessing otitis media with effusion.

The form of audiometric assessment depends on the patient's age and ability.

Early treatment of acute otitis media may be required in patients with risk factors.

Otitis media with effusion without risk factors can be addressed with a 'watch and wait' approach as the majority of cases will improve spontaneously by three months.

Hearing loss in children

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BACKGROUND

HEARING loss is a common issue, and within the Australian paediatric population, approximately 3% experience long-term ear/hearing problems.[1] Although the rate is substantially lower than in the adult population, hearing loss in a child can have significant effects on language and cognitive development, behaviour, literacy and social skills, potentially leading to long-term academic and professional underachievement.[2,3] This hearing loss may also impact the family and be associated with greater stress and increased financial burden.[4]

Numerous factors contribute the degree that hearing loss impacts a child (see box 1).[4]

Certain patient groups are at increased risk of hearing-related disease and complications, and may require earlier and more aggressive intervention. Risk factors for permanent congenital or progressive hearing loss of childhood include prematurity, syndromic conditions, craniofacial abnormalities or a family history of hearing loss.[5]

Box 1. Factors influencing the impact of hearing loss

- Age of onset: with the impact greatest when younger.
- Degree of hearing loss.
- Age of identification and intervention: earlier detection and intervention improves outcomes. Ideally, children with hearing loss should receive intervention by six months of age.
- Environment: access to hearing technology, special education and other hearing impairment support improves outcomes.

Australian Indigenous children are three times as likely as their non-Indigenous counterparts to experience ear/hearing problems between birth and 14 years.[1] This may be attributed to social factors such socioeconomic disadvantage and decreased access to health care, as well as environmental factors such as overcrowding and greater passive exposure to tobacco smoke.[1,6]

This How to Treat discusses the common causes for hearing loss within the paediatric population and provides a framework for further assessment and management.

AETIOLOGY

HEARING loss can be divided into two categories — conductive or sensorineural. Conductive hearing loss is more common in children. Table 1 lists some causes of hearing loss within the paediatric population.

Conductive hearing loss

CERUMEN

Cerumen serves an important role in ear canal microbiome homeostasis and water protection. Impaction is a common problem in the paediatric population, with excessive or impacted cerumen present in 10% of children.[7]

Cerumen is normally expelled from the ear canal by a self-cleaning mechanism; however, when this mechanism fails, children may develop symptoms such as hearing loss, aural fullness, otalgia, tinnitus, discharge and/or odour.[8]

Otoscopy may demonstrate cerumen of various colours (for example, red, black, yellow, brown, white) and textures (such as liquid to rock hard).

ACUTE OTITIS MEDIA

Acute otitis media (AOM) is a very common presenting complaint in children, with more than 80% of children having had one episode by three years of age.[9] AOM is defined as an acute onset of middle-ear effusion with signs of inflammation such as otalgia, otorrhoea and fevers.[10]

AOM may lead to acute perforation of the tympanic membrane (TM) with a classic history of worsening pain and sudden relief, followed by otorrhoea and/or bleeding. Risk factors are listed in box 2.[11]

In children, symptoms of AOM can be non-specific and include hearing loss, tinnitus, tugging of ears, irritability, headaches, fevers, poor sleep and poor feeding, and may be associated with other URTI symptoms. The most reliable sign is otalgia, with otorrhoea being present after perforation.[12]

Otoscopy commonly demonstrates a bulging, erythematous, injected TM, with evidence of a middle-ear effusion (air fluid level, opacification) and a non-mobile TM ▸

◂ on pneumatic otoscopy. Tuning fork examination, if practicable, will demonstrate a conductive hearing loss to the affected side.

OTITIS EXTERNA

Otitis externa (also known as swimmer's ear) is a diffuse inflammation of the external auditory canal, that may also involve the pinna or tympanic membrane.[13] It may occur as part of an infective, allergic or dermatological process. The most common form is an acute bacterial otitis externa, with *Pseudomonas* the most common causative organism.[14]

Common symptoms include otalgia, pruritis, discharge and hearing loss. External auditory canal, tragal and auricular tenderness are often present and may occur with or without otorrhoea and lymphadenopathy.

Ask about use of cotton tips or ear instrumentation. Otoscopy commonly demonstrates canal erythema/swelling, often associated with yellow/brown/white debris (see figure 2). It may not be possible to visualise the TM, but if seen, the drum is frequently normal.

Severe disease is characterised by periauricular/facial erythema, postauricular/cervical lymphadenopathy and systemic features such a fevers and rigors.

Risk factors include for otitis externa are listed in box 3.

OTITIS MEDIA WITH EFFUSION

Otitis media with effusion is the presence of fluid in the middle ear without signs or symptoms of acute infection.[15] It may be triggered by an URTI or because of Eustachian tube dysfunction or obstruction.

Symptoms include hearing loss, disequilibrium/stumbling, poor academic performance, behavioural issues, and recurrent AOM.

If the condition persists for longer than three months, is termed chronic otitis media with effusion.[15] It is at this stage of the condition when more significant long-term complications, such as delay in speech and language development, with associated detrimental effects on education, may occur.

Otoscopy commonly demonstrates evidence of an effusion (air fluid levels, bubbles), a dull grey/yellow TM, retraction of the TM and/or an immobile drum on pneumatic otoscopy.

Risk factors are listed in box 4.

Sensorineural hearing loss

Sensorineural hearing loss (SNHL) in children can be particularly challenging to recognise as children are often able to use vision and other sensory cues to effectively respond to their environment. Subtle hints such as failure to startle may be present in infants with profound SNHL.[16]

Hearing loss in older infants may present as poor development of speech and language milestones. Imbalance and vestibular dysfunction may be present in children with profound hearing loss.

Common parental concerns that may indicate sensorineural hearing loss include increased volume of radio/television/computer; poor attention at school; and inability or difficulty following instructions associated with repetitive questioning ("huh?" or "what?").

Table 1. Aetiology of paediatric hearing loss

Conductive hearing loss	
Outer ear	• Cerumen (wax) impaction • Otitis externa • Congenital causes: canal stenosis, microtia
Middle ear	• Acute otitis media (see figure 1) • Otitis media with effusion • Tympanic membrane perforation • Cholesteatoma • Ossicular chain abnormalities
Sensorineural hearing loss	
Acquired	• Iatrogenic: ototoxic medications • Infection: meningitis, chronic suppurative otitis media • Trauma • Noise exposure • Tumours: vestibular schwannoma • Others: hyperbilirubinaemia, heavy metal exposure
Congenital	• Genetic susceptibility: mutation of connexin 26 (cx26), a protein found on the GJB2 gene • Syndrome related • Infective: TORCH (toxoplasmosis, other [syphilis], rubella, cytomegalovirus, herpes simplex virus) • Inner-ear malformations

Box 2. Risk factors for otitis media

- Age: with peaks in incidence between six and 18 months.
- Ethnicity: Indigenous Australians are at particular risk.
- Family history of AOM.
- Social and economic conditions: poverty and overcrowding increase risk.
- Gastroesophageal reflux.

Box 3. Risk factors for otitis externa

- Water exposure: moisture leads to breakdown of the skin-cerumen barrier and the pH increases.
- Trauma: from cotton tips and abrasive canal cleaning.
- Pre-existing dermatological conditions.

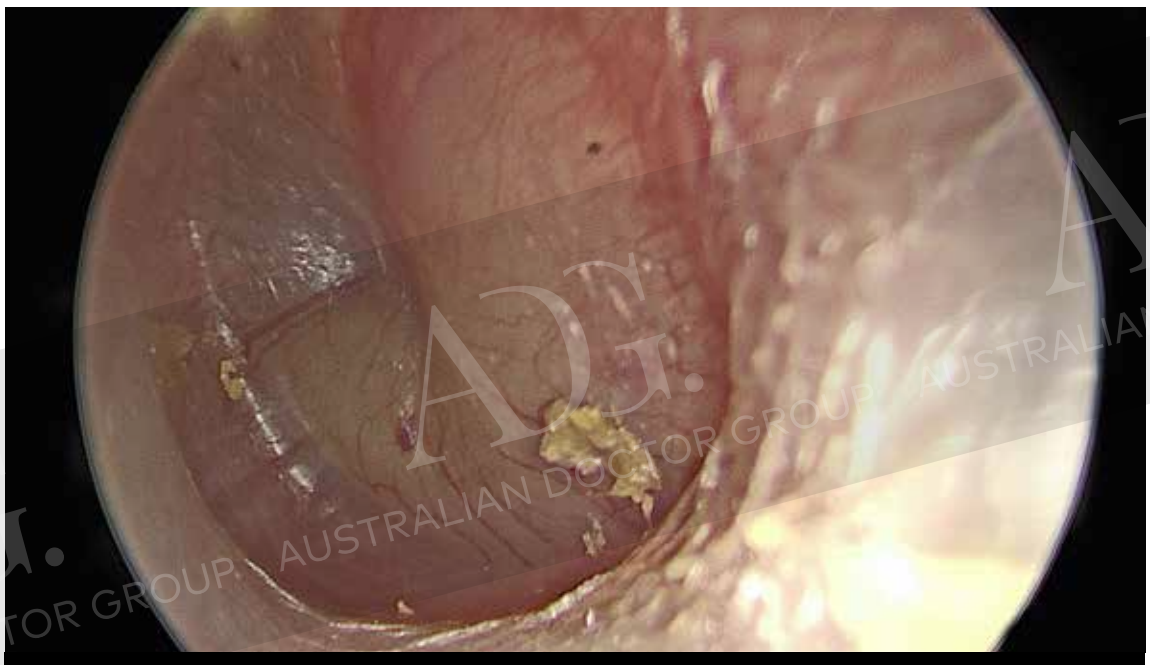


Figure 1. Acute otitis media. Erythematous, hypervascular tympanic membrane with purulent material behind the tympanic membrane.

Identifying risk factors (see box 5) for sensorineural hearing loss is essential as the history and examination findings are often limited.

Physical examination in children with sensorineural hearing loss is typically unremarkable but syndromic features may guide the clinician to the diagnosis.[16]

EXAMINATION

ROUTINELY review speech and development milestones in all infants (see table 2).

Sensorineural hearing loss in children can be challenging to recognise as they are often able to use vision and other ... cues to respond to their environment.

Note other examination findings of craniofacial anomalies, particularly ear pits, ear tags, and external canal or pinna deformities.

A useful mnemonic for otoscopic examination is 'COMPLETE' (see table 3).

Note that in the paediatric population, a red but translucent TM suggests blood vessel engorgement typically associated with crying or sneezing. However, a red and bulging or full TM suggests AOM. In OME the TM will classically appear dull and retracted. Opacification of the TM is an indicator of middle-ear effusion, but when scarring (myringosclerosis), has occurred, this can be a sign of previous perforation and infection.

Pneumatic otoscopy is a simple and effective tool in assessing for OME, with a sensitivity of 94% and specificity of 80%.[17] A good seal between otoscope speculum and EAC, using the largest speculum comfortable, must be obtained before effective pneumatic otoscopy can occur. Puffing of the bulb attached to the otoscope will then demonstrate TM mobility. A normal TM should move briskly. Mobility is reduced or absent in cases of middle ear effusion or a scarred TM. Pneumatic otoscopy also assists in the detection of other features of middle ear effusion such as bubbling or fluid levels.

Tuning fork examination, such as the Rinne or Weber test, may be performed in children to help determine whether there is conductive or sensorineural hearing loss. A 256Hz or 512Hz tuning fork should be used.

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 heard, whether it is central or to one side.

A Rinne test assesses both bone and air conduction. Bone conduction is assessed by placing the base of a vibrating tuning fork on bone behind the ear. When bone conduction decays to the point that it cannot be heard, the tuning fork is removed from behind the ear and tines of the fork placed parallel and roughly 3cm from the external auditory canal. This assesses air conduction, and if the sound is again heard, air conduction is better than bone conduction.

A normal test is described as positive. A negative/abnormal Rinne test indicates conductive hearing loss.

Box 4. Risk factors for otitis media with effusion

- Indigenous population.
- Low socioeconomic status.
- Exposure to tobacco smoke.
- Craniofacial abnormalities such as cleft palate.

Box 5. Risk factors for sensorineural hearing loss

- Family history: previous hearing loss in siblings or relatives, consanguinity.
- Perinatal history: prematurity, neonatal intensive care admission.
- Other: infections such as bacterial meningitis, trauma and brain injury, immunisation status.

INVESTIGATIONS

Newborn hearing screening

THE Australian newborn screen uses the automated auditory brain stem response (AABR) and otoacoustic emissions (OAE). These are screening tools and are not intended to be diagnostic.

AUTOMATED AUDITORY BRAINSTEM RESPONSE

In an automated auditory brainstem response screening, a series of scalp electrodes are placed on the child's head. A stimulus sound is presented to the ear, and the transmitted electrical activity recorded. These generated peaks reflect the activation of the auditory pathway from cochlear nerve through to the afferent auditory pathway.[18] These results are applied to an algorithm which produces a 'pass' or 'refer' determination, with subsequent referral for diagnostic audiometric assessment if required.

OTOACOUSTIC EMISSIONS

In an otoacoustic emissions (and evoked otoacoustic emissions [EOAE]) screening, a brief click is presented to the sealed ear of the child and the subsequent EOAE produced by the inner-ear hair cells is transmitted from the cochlea, to the middle ear and then recorded by a microphone in the canal. Consequently, middle-ear pathology or external-ear obstruction may interfere with results.[19]
An acceptable response typically occurs when hearing is better than 20dB, indicating an acceptable hearing threshold.

VISUAL REINFORCEMENT ORIENTATION AUDIOMETRY

Visual response audiometry can usually be performed in children from around six months to two-and-a-half years of age. This involves reinforcing sound stimulus with visual stimulus (such as toys or videos) so that the child will eventually look towards the direction of the sound (orientating response).

This form of assessment assumes that the child can see and respond to visual stimulus, and because of its subjective nature, should be performed by an experienced paediatric audiologist.

CONDITIONED PLAY AUDIOMETRY

Similar to visual reinforcement audiometry, play audiometry involves reinforcing sound stimulus to any sort of discrete response. This is often performed for children from two-and-a-half to four years of age. Conditioned play audiometry should be individualised and may involve the throwing of a ball, putting a block into a container or placing a piece into a puzzle based on the sound.[19]

PAGE 14 ▸

Table 2. Normal language milestones

Hearing and understanding	Talking
0-3 months • Startles to loud sounds • Quiets or smiles when parents talk • Seems to recognise parent's voice; this quiets crying	• Makes cooing sounds • Cries change for different needs • Smiles at people
4-6 months • Moves eyes in direction of sounds • Responds to changes in tone • Notices toys that make sounds • Pays attention to music	• Coos and babbles when playing alone or with parent • Makes speech like babbling — pa, ba, mi • Giggles and laughs • Makes sounds when happy or upset
7-12 months • Turns and looks in direction of sound • Turns head with name calling • Understands words for common items and people — cup, truck, juice, Mummy, Daddy • Response to simple words and phrases — "no", "come here", "want more?" • Plays games such as peek-a-boo • Listens to songs and stories for a short time	• Babbles long strings of sounds — mimi, upup, babababa • Uses sounds and gestures like waving goodbye, reaching for 'up' and shaking head for 'no' • Imitates different speech sounds • Says one or two words — hi, dog, dada, mama, uh-oh, etc
1-2 years • Points to a few body parts when asked • Follows one-part direction — "roll the ball" or "kiss the baby" • Responds to simple questions — "who is that?", "where is your shoe?" • Listens to simple stories, songs and rhymes • Points to pictures in a book when you name them	• Uses a lot of new words • Uses p, b, m, h and w words • Starts to name pictures in books • Ask questions such as "what's that?", "who's that?", "where's kitty?" • Puts two words together — "more apple", "no bed", "Mummy book"
2-3 years • Understands opposites — go/stop, big/little, up/down • Follows two-part directions — "get the spoon and put it on the table" • Understands new words quickly	• Has a word for almost everything • Talks about things that are not in the room • Uses k, g, f, t, d, and n in words • Uses words such as in, on and under • Uses 2-3 words to talk about and ask for things • People know your child can understand them • Asks why • Puts three words together to talk about things
3-4 years • Responds when called from another room • Understands words for some colours — red, blue, green • Understand words for some shapes — circle, square • Understands words for family — brother, aunt, grandmother	• Answers simple who, what and where questions • Says rhyming words such as hat/cat • Uses pronouns such as I, you, me, we and they • Uses some plural words such as toys, birds and buses • Can be understood by most people • Asks 'when' and 'how' questions • Puts four words together — may make some mistakes • Talks about what happens during the day. Uses about four sentences at a time
4-5 years • Understands words with order — first, next, last • Understands words for time — yesterday, today • Follows longer directions — "put your pyjamas on, brush your teeth, and then pick out a book" • Follows classroom instructions — "draw a circle on your paper around something you eat" • Hears and understands most of what is said at home and school	• Says most sounds correctly, except for harder ones — l, s, r, v, z, ch, sh, and th • Responds to "what did you say?" • Talks without repeating sounds or words most of the time • Names letters and numbers • Uses sentences that have more than one action word • Tells a short story • Keeps a conversation going • Talks in different ways depending on the listener and place — eg, outside vs inside

Adapted from Amercian Speech-Language-Hearing Association[30]

Table 3. Otoscopic examination

Mnemonic	Features
Colour	White, red, yellow, blue or grey
Other conditions	Retraction, perforation, myringosclerosis (see figure 3), cholesteatoma, fluid level, bubbles, thickened tympanic membrane
Mobility	Movement of tympanic membrane on Valsalva or pneumatic otoscopy
Position	Neutral, retraction or bulging
Lighting	Light reflex
Entire surface	Ensure all quadrants and margins of tympanic membrane visualised
Translucency	Dull or translucent
External auditory canal	Polyp, granulation, ulcers/herpetic lesions, swelling, erythema, discharge or bony outgrowths

Box 6. Management options for cerumen

- Manual instrumentation: with adequate visualisation using otoscope, headlamps or microscopes, the clinician can use curettes, forceps, suction tips or a Jobson-Horne probe to remove wax. A binocular microscope has the advantage of stereoscopic magnification.
  - Preferable for patients with known TM perforations, external canal abnormalities, recent surgery or grommets.
  - Complications include bleeding, laceration, perforation and otalgia.
- Irrigation can be performed with syringe or electronic irrigator:
  - Irrigation should not be performed in patients with TM perforations/grommets or concerns about perforation, particularly those with thin and atrophic TMs. Irrigation should also be avoided in patients with anatomical abnormalities of the ear canal.
  - Complications include pain, otitis externa, TM perforation, vertigo (particularly if irrigation solution is not at body temperature).
- Cerumenolytics have been demonstrated to be better than no treatment, however no significant difference has been identified between water/saline or commercially produced cerumenolytics.[20] Cerumenolytics can be used in conjunction with other techniques to aid removal.
  - Avoid cerumenolytics in patients with active ear canal infections such as otitis externa.
  - Complications include local skin irritation and discomfort.

Box 7. High-risk groups requiring urgent antibiotic therapy

- Infants younger than six months.
- Children younger than two years with bilateral infection.
- Children who appear toxic: persistent otalgia, lethargy, paleness, irritability.
- Aboriginal and Torres Strait Islander populations.
- Children at risk of complications: those who are immunosuppressed, have AOM in the only hearing ear, or cochlear implants.

◂PAGE 12

PURE TONE AUDIOMETRY

Pure tone audiometry is the most common method used to assess hearing and is often combined with speech audiometry and tympanometry as part of a routine audiometric assessment.

Examination occurs in a soundproof room where the child is exposed to different intensities and frequencies of sound and asked to indicate when the stimulus is heard. The thresholds are identified as the lowest sound intensity in which 50% of the stimulus can be detected.[18] This test is performed for both air and bone conduction.

Pure tone audiometry can demonstrate normal hearing, or conductive, sensorineural or mixed hearing loss. The degree of loss is categorised as in figure 4A. Figures 4B-D illustrate various forms of hearing loss.

SPEECH AUDIOMETRY

Speech audiometry involves presenting words at adjusted volumes and asking the child to repeat them back. Speech recognition threshold is generated, which is the lowest decibel at which the patient can repeat the word in 50% of presentations. Poor perception may reflect central causes for hearing loss.

Speech recognition threshold is … the lowest decibel at which the patient can repeat the word in 50% of presentations.

TYMPANOMETRY

This is a measure of middle ear function, assessed through the measurement of tympanic membrane compliance. A probe is inserted into a sealed ear canal and the tympanometry device generates a pressure change within the external canal,

Figure 2. Fungal otitis externa (otomycosis) — significant amount of hyphae are present.

moving the tympanic membrane. The point of maximum compliance indicates that the canal pressure is equal to middle ear pressure. Figure 5 illustrates common tympanometry results.

Figure 6 demonstrates the appropriate audiometric test based on age.

Sixty per cent of children recover from acute otitis media within the first 24 hours whether or not they have received antibiotics.

MANAGEMENT

Cerumen

THE management of cerumen depends on the associated symptoms. In the absence of symptoms, or necessity for TM assessment, cerumen should be left in place.[7]

Pay particular attention to the population of patients with limited expressive language, in whom cerumen should be removed.[7] Management options for cerumen are listed in box 6.[7]

Acute otitis media

The management of AOM often involves a 'watch and wait' approach; in most children antibiotic treatment can be withheld, with 60% recovering within the first 24 hours whether or not they have received antibiotics.[21]

A 2015 meta-analysis demonstrated that early antibiotics only had a small effect on pain in the days following an infection, but did reduce the rate of tympanic membrane perforation and contralateral episodes of AOM.[21] There was no evidence of abnormal tympanometry findings at the three-month mark, and serious complications such as mastoiditis and meningitis were rare in both those receiving and those not receiving antibiotic therapy. Antibiotic use was associated with an increased risk of adverse events such as diarrhoea, vomiting and rash.

Up-to-date vaccinations, particularly for *Streptococcus pneumoniae*, are helpful in the reduction of rates of streptococcal AOM.[22]

The Australian Therapeutic Guidelines outline high-risk groups that often require more urgent antibiotic therapy (see box 7).[23]

Consider referral to an ENT surgeon if there are three or more episodes of AOM in six months or four or more episodes in 12 months or if complications such as mastoiditis or facial nerve palsy occur, and in at-risk populations.[23,24]

Figure 7 outlines the treatment of acute otitis media.

Otitis media with effusion

Similarly, the management of this condition involves a 'watch and wait' approach. It is reasonable to re-evaluate the child at three-monthly intervals as around 75% of children with OME following AOM resolve by three months.[15]

The initial treatment includes mitigation of modifiable risk factors where possible, including pneumococcal vaccination, removal of tobacco smoke from the child's environment, reduction of daycare exposure and good hand hygiene.

Cessation of pacifier use in children younger than 18 months decreases the risk of AOM and subsequently OME.[25] There is no role for antihistamines, decongestants, anti-reflux medications or intranasal corticosteroids, unless the treatment as aimed at other aetiologies.[15] Educate parents about the implications of hearing loss.

Persistent hearing loss from OME (more than three months) should prompt referral to an ENT surgeon for review and potential surgical ▸

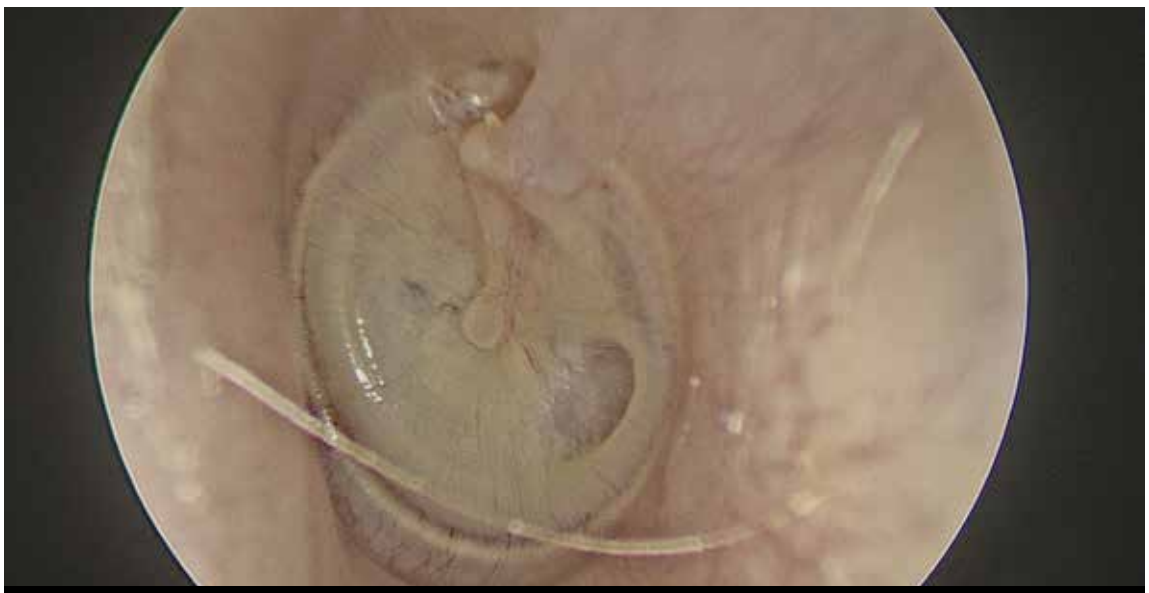


Figure 3. Otitis media with effusion, with myringosclerosis (white, sclerotic tympanic membrane) with retraction. The middle-ear space appears dull.

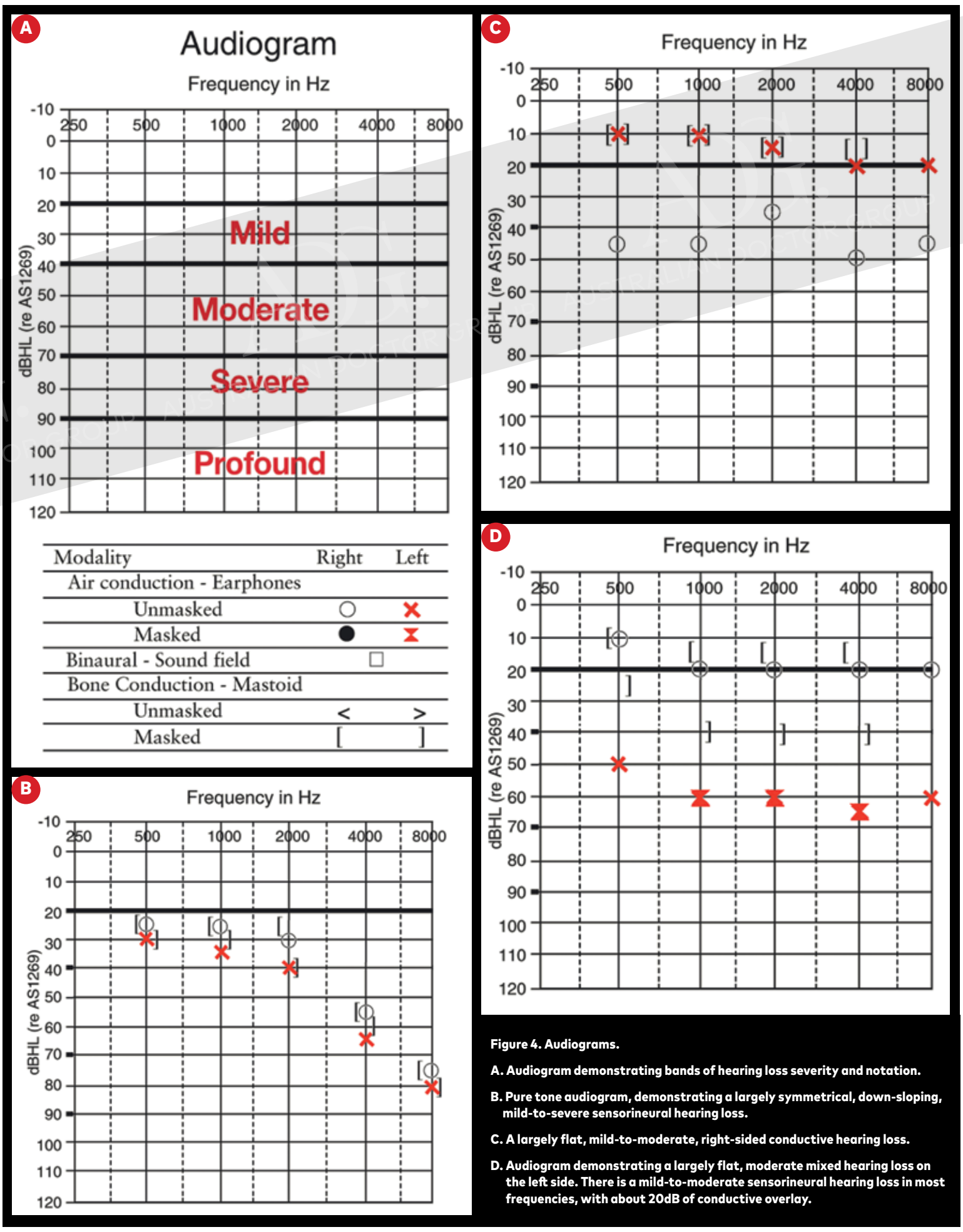


Figure 4. Audiograms.

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.

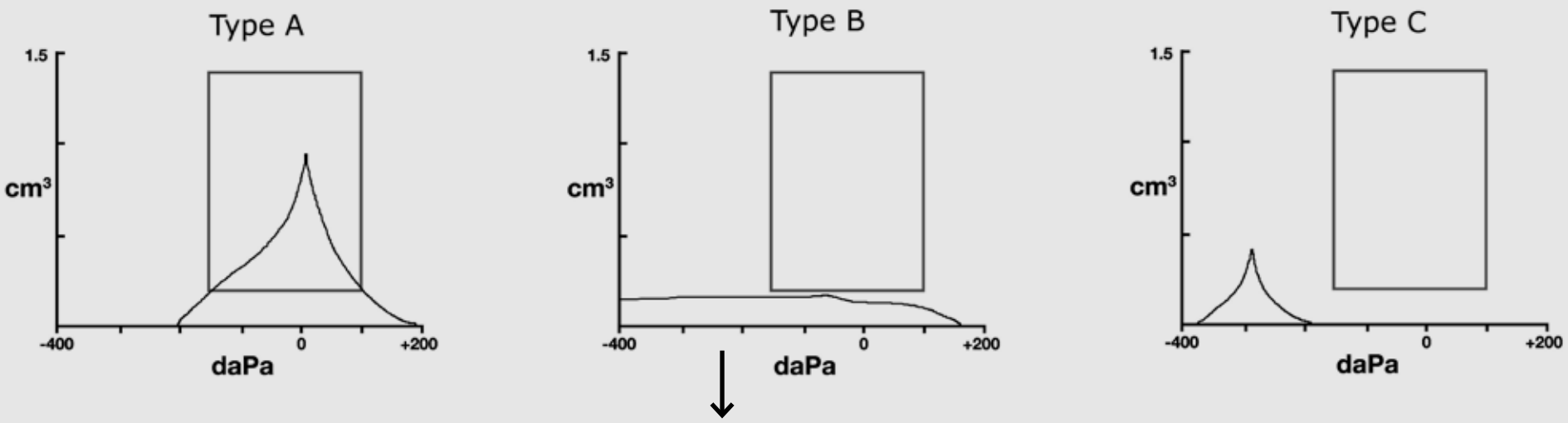


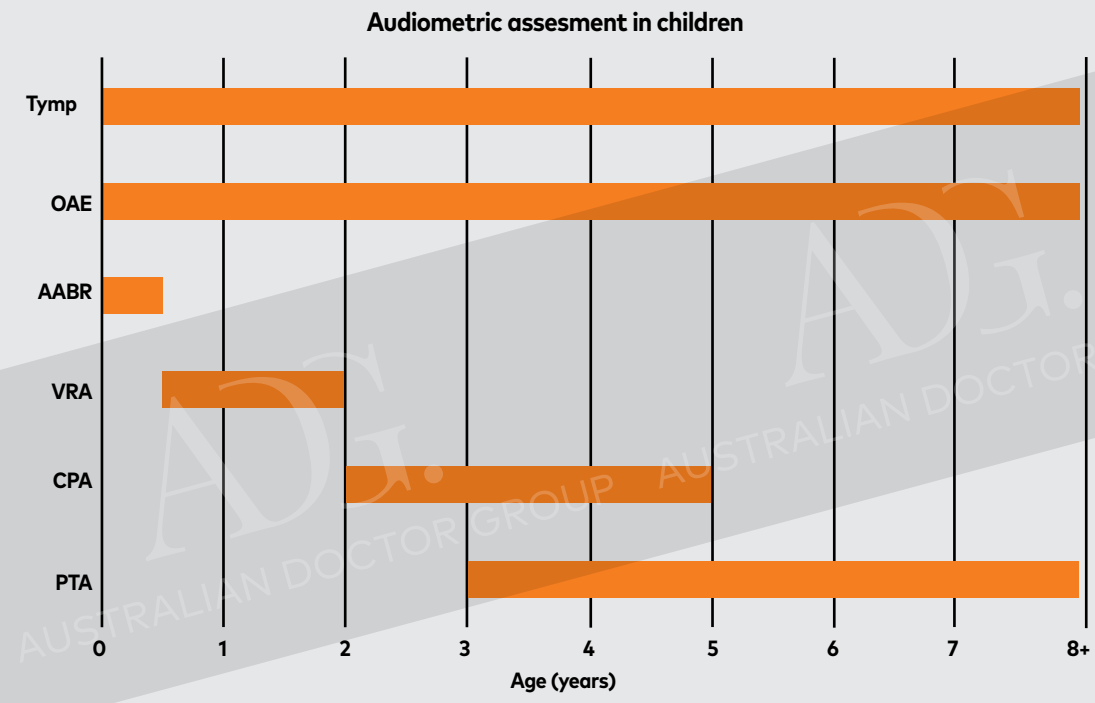
Figure 5. Tympanograms.

Normal (type A) tympanogram.

Flat (type B) tympanogram indicating middle-ear effusion.

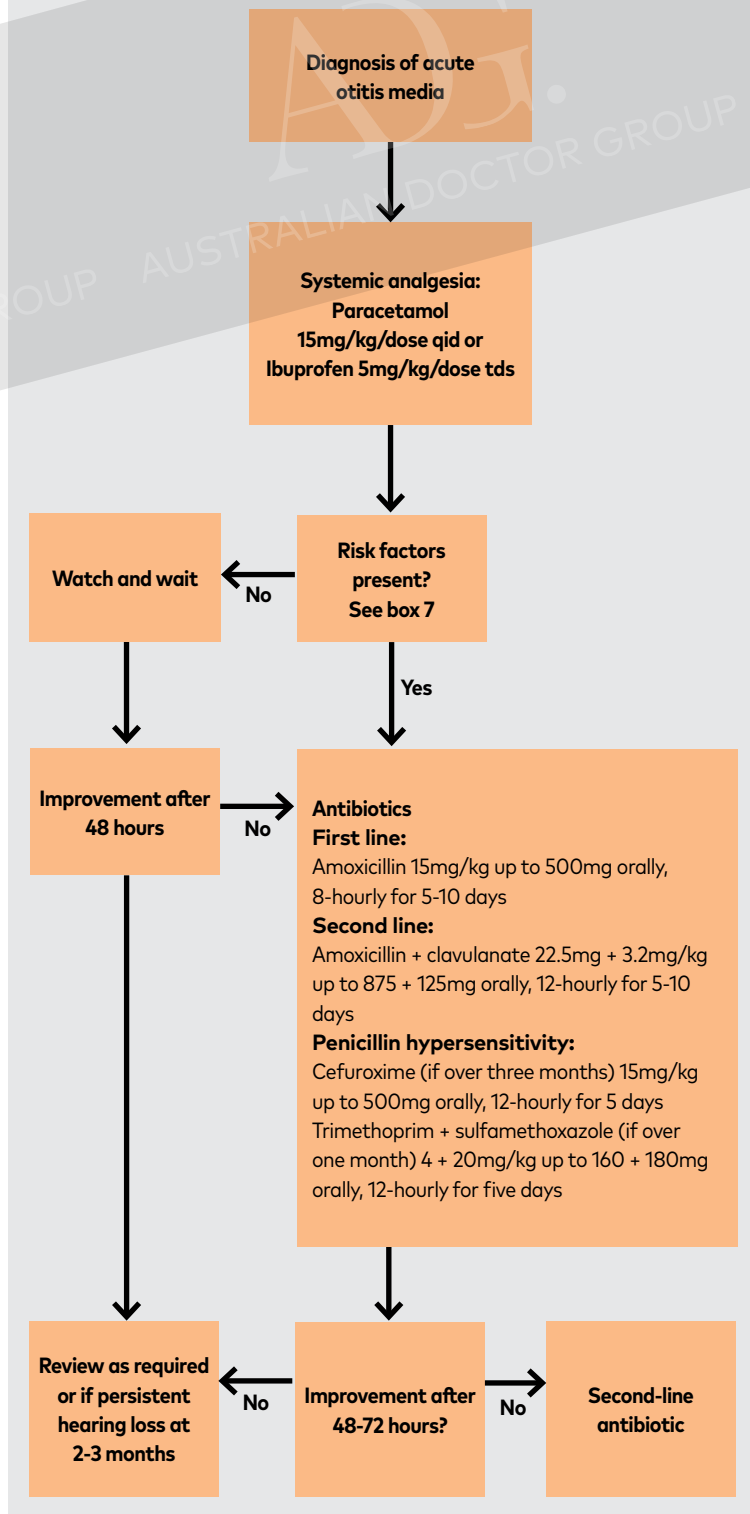
Left-shifted (type C) tympanogram, indicating eustachian tube dysfunction.

Figure 6. Appropriate audiometric assessment based on age.



- Tymp: Tympanometry
- OAE: Otoacoustic emissions
- AABR: Automated auditory brainstem response
- VRA: Visual reinforcement orientation audiometry
- CPA: Conditioned play audiometry
- PTA: Pure tone audiometry

Figure 7. The management of acute otitis media.



◂ intervention. Myringotomy and insertion of ventilation tubes (grommets) is the mainstay of treatment, with some children requiring multiple sets throughout their lives (see figure 8).

Adenoidectomy is considered in children older than four years or those requiring repeat grommets.[26] Involve a speech pathologist if there is a chronic OME with speech or language delays.

Otitis externa

The management of acute otitis externa (see figure 2) begins with dry aural toilet (performed under direct visualisation) with either mechanical suction, probe or cotton wool.[23] Ototopicals are often used (see table 4). However, before starting these, it is important to assess for a perforated tympanic membrane or tympanostomy tubes (grommets). This is because of the potential for ototoxicity from commonly prescribed formulations that include aminoglycosides (dexamethasone + framycetin + gramicidin drops). They are unlikely to cause ototoxicity after a short course, but may with repetitive administration.[13] In these situations, ciprofloxacin-based drops are preferred.[23]

Table 4. Treatment of acute otitis externa

Consideration	Treatment
Ototopicals if fungal condition is not suspected	Dexamethasone + framycetin + gramicidin 0.05% + 0.5% + 0.005% ear drops, three drops instilled into the affected ear, three times daily for seven days OR Flumethasone + clioquinol 0.02% + 1% ear drops, three drops instilled into the affected ear, twice daily for seven days
Ototopicals if there are concerns about perforation/ grommet	Ciprofloxacin + hydrocortisone 0.2% + 1% ear drops, three drops instilled into the affected ear, twice daily for seven days
Systemic antibiotics	Dicloxacillin/flucloxacillin (12.5mg/kg up to 500mg) orally, six-hourly for 7-10 days PLUS Ciprofloxacin (20mg/kg up to 750mg) orally, 12-hourly for 7-10 days

Based on eTG 2020[23]

If ear drops cannot be adequately instilled because of canal occlusion, a wick may be required. Removal of discharge or debris by mopping the ears with rolled tissue spears is particularly useful before drops are instilled. For effective drop instillation, have the patient lying down with the affected ear up and pump the tragus, although this is not always possible in children.[13]

Systemic antibiotics are not routinely recommended as initial therapy unless there is extension outside of the ear canal or the presence of risk factors such as immunosuppression.[13] If required, systemic antibiotic therapy is guided by microbiological results (see table 4).

Prevention of otitis

PAGE 18 ▸

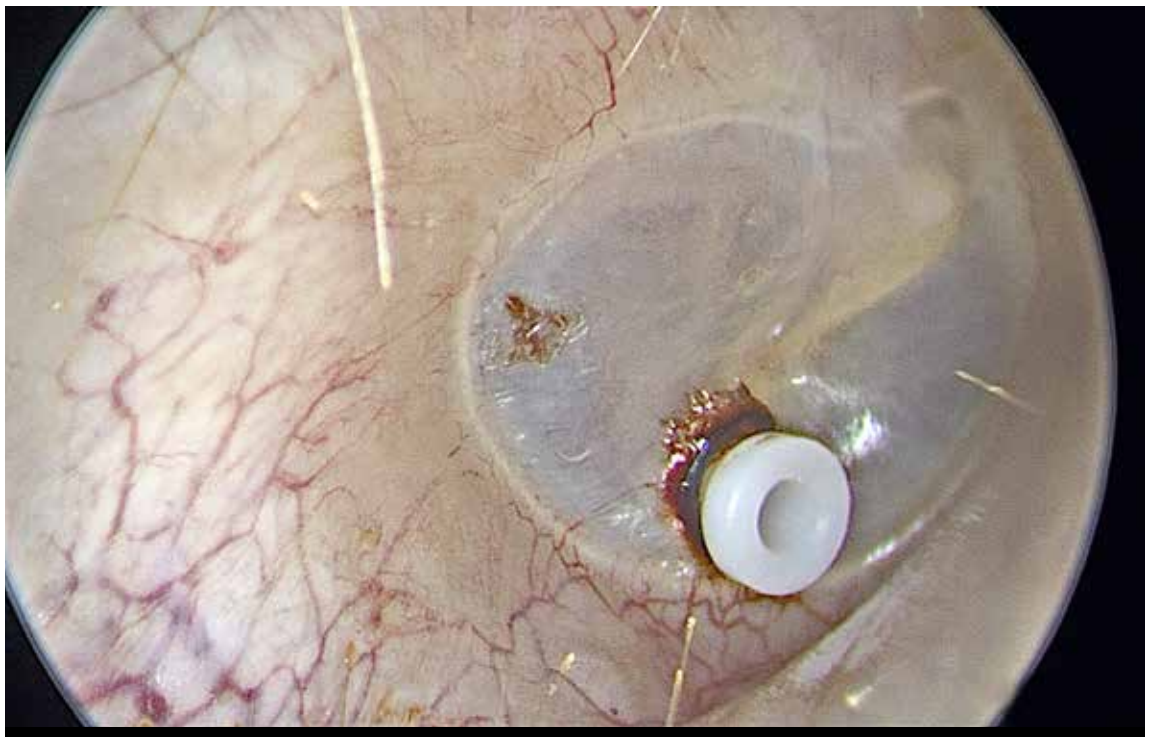


Figure 8. Grommet in situ within the tympanic membrane.

◂PAGE 16 externa involves avoidance of water within the ear canal for at least two weeks after treatment. During treatment, showering or bathing caps can be used. Following treatment of an acute episode, acetic acid plus isopropyl alcohol ear drops can be used after water exposure.[13]

Sensorineural hearing loss

Infants with SNHL detected at birth in Australia are managed as part of a multidisciplinary team including paediatrician, ENT surgeon, ophthalmologist, audiologist and speech pathologist. Early detection is key in this population, and intervention should be started as early as possible, ideally before six months of age.[27]

Different treatment options are available, depending on the severity and aetiology of the hearing loss, (see box 8).[28,29]

CASE STUDIES

Case study one

HAMISH, three, is brought to see his GP by his mum who is concerned by his lack of language development. She is worried that he is falling behind other children his age. She tells the GP that Hamish uses short 2-3 word phrases but they "do not sound right". Hamish has also started speaking much more loudly around the house in the past 3-4 weeks.

He is otherwise healthy, and his vaccinations are up-to-date.

On examination, otoscopy reveals bilaterally dull tympanic membranes, without erythema or hypervascularity. He is otherwise systemically well. The GP is concerned about an otitis media with effusion.

Hamish is referred to an audiologist who performs conditioned play audiometry, demonstrating hearing thresholds of 35dB across the tested ranges.

When Hamish is reviewed two months later, his mum notes that his speech is unchanged. On examination, he has bilaterally dull tympanic membranes, without erythema or hypervascularity.

Hamish is referred to an ENT surgeon and undergoes uneventful day surgery for bilateral myringotomy and insertion of tympanostomy tubes (grommets). His postoperative audiogram demonstrates hearing within normal limits.

Three months after surgery, at GP review, his mother notes significant improvement. Hamish is not speaking as loudly and is more attentive, something she had previously attributed to 'selective hearing'.

Twelve months postoperatively, when Hamish presents for routine DTPa-IPV, the GP notices on otoscopy that the grommets are no longer present.

When next seen at age six for a viral URTI, the GP notes Hamish has caught up with his peers and is progressing well in school.

Box 8. Management options for sensorineural hearing loss

- Medical management
  - Referral: paediatrician, ENT surgeon, ophthalmologist, geneticist as required.
  - Early diagnosis and treatment of ear-related disease (such as AOM in the only hearing ear).
  - Ongoing education of families and monitoring.
  - Hearing assistance devices: hearing aids, remote microphone technologies, bone-anchored hearing devices, cochlear implants.
- Audiological management: early intervention programs with speech pathologist.

Case study two

Leila, an otherwise healthy eight-year-old Indigenous girl, is brought to her GP by her parents. Leila has a three-day history of otalgia with fevers and complains of reduced hearing on the right, associated with the sensation of aural fullness.

Otoscopic examination reveals an erythematous and bulging right tympanic membrane. Tuning fork tests demonstrate a right-sided Weber's test with a positive Rinne's on the left, and negative on the right. The GP makes a diagnosis of acute otitis media. Leila's symptoms resolve on a 10-day course of oral amoxicillin.

Three weeks later, Leila is back at the GP with a 24-hour history of fevers and otalgia, and a five-day history of vague occipitoparietal headaches. Otoscopic examination reveals normal tympanic membranes bilaterally. A forward-displaced area of indurated, erythematous skin behind the right ear overlying the mastoid bone is noted. There is no obvious fluctuance behind the ear. There are no cranial nerve or focal neurological deficits or gross disequilibrium.

The GP is concerned about a masked mastoiditis and refers Leila urgently to ED for further assessment. Her bloods demonstrate a significant neutrophilia with a count of $16x10^9$/L (normal: 1.8-7.7) with a CRP of 312mg/L (normal: less than 5). CT-brain demonstrates coalescent (bone-destroying) mastoiditis with mastoid antrum obstruction.

During her hospitalisation, Leila is managed with IV antibiotics in the first 24 hours, with the intention to escalate therapy should conservative measures fail. She improves during the next 72 hours, with the erythema and swelling behind her ear gradually subsiding.

Leila is discharged on a course of prolonged IV antibiotics via an infuser, with regular ENT follow-up.

CONCLUSION

HEARING loss within the paediatric population is common. This may lead to profound effects on a child's language, cognitive development, behaviour, literacy and social skills, potentially leading to long-term academic and professional underachievement. Early assessment of hearing loss is essential, particularly in the at-risk populations, to reduce the time without adequate hearing for learning and development. The GP is at the forefront of managing the subjective and often ambiguous complaint of hearing loss, and together with audiologists, speech pathologists, paediatricians and ENT surgeons, is well placed to optimise their young patients' health outcomes.

References on request from howtotreat@adg.com.au

How to Treat Quiz.

HEARING LOSS IN CHILDREN

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1. **Which THREE are risk factors for permanent congenital or progressive hearing loss of childhood?**
   - **a** Prematurity.
   - **b** Craniofacial abnormalities.
   - **c** Family history of hearing loss.
   - **d** Water exposure.

2. **Which TWO statements regarding hearing loss in children are correct?**
   - **a** The most common cause of hearing loss in children is sensorineural.
   - **b** Australian Indigenous children are three times as likely as their non-Indigenous counterparts to experience ear/hearing problems between birth and 14 years.
   - **c** Most children with OME following AOM require grommets.
   - **d** Numerous factors contribute to the degree that hearing loss impacts a child.

3. **Which THREE statements regarding impacted cerumen are correct?**
   - **a** Impacted cerumen may cause hearing loss, aural fullness, otalgia, tinnitus, discharge and/or odour.
   - **b** All cerumen should be removed.
   - **c** Manual instrumentation is preferred in patients with known TM perforations, external canal abnormalities, recent surgery or grommets.
   - **d** Cerumenolytics can be used in conjunction with other techniques to aid removal.

4. **Which ONE is the most reliable sign of acute otitis media in children?**
   - **a** Tugging of ears and irritability.
   - **b** Fever.
   - **c** Otalgia.
   - **d** Poor feeding.

5. **Which THREE high-risk groups require urgent antibiotic therapy for acute otitis media?**
   - **a** Children who appear toxic.
   - **b** Aboriginal and Torres Strait Islander children.
   - **c** Children at risk of complications, eg, those who have cochlear implants.
   - **d** Children with a third episode of AOM in a 12-month period.

6. **Which TWO statements regarding otitis externa are correct?**
   - **a** *Staphylococcus aureus* is the most common causative organism.
   - **b** Risk factors include water exposure, trauma and pre-existing dermatological conditions.
   - **c** Systemic antibiotics should be prescribed routinely in the treatment of otitis externa.
   - **d** Ear drops containing aminoglycoside can be used to treat otitis externa in the absence of tympanic membrane perforation or grommets.

7. **Which THREE are risk factors for otitis media with effusion?**
   - **a** Indigenous population.
   - **b** Craniofacial abnormalities such as cleft palate.
   - **c** Exposure to loud noise.
   - **d** Low socioeconomic status.

8. **Which TWO are most likely to be features of sensorineural hearing loss in children?**
   - **a** Bilateral cerumen impaction.
   - **b** Failure to startle.
   - **c** Enuresis.
   - **d** Impaired language development.

9. **Which THREE statements regarding examination in a child with hearing loss are correct?**
   - **a** A red drum in a child is always indicative of AOM.
   - **b** Routinely review speech and development milestones in all infants.
   - **c** A normal TM should move briskly on pneumatic otoscopy.
   - **d** Tuning-fork examination helps determine whether there is conductive or sensorineural hearing loss.

10. **Which TWO audiometric assessments are suitable in children of all ages?**
    - **a** Pure tone audiometry.
    - **b** Tympanometry.
    - **c** Visual reinforcement orientation audiometry.
    - **d** Otoacoustic emissions.

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