

Silencing tinnitus



Tinnitus is a common, but frustrating problem for both patients and clinicians. In the majority of people tinnitus is a subjective, neurophysiological problem. However, it is important to identify people who are hearing genuine sounds generated within the body (objective tinnitus) or have some other underlying treatable condition. Subjective tinnitus arises within the brain, but may be triggered by and/or predisposed to, changes in the ear, in any part of the auditory pathway, by other related structures and sensory pathways, by emotional factors and by conditions that have an indirect effect such as metabolic disorders. There is no cure for subjective tinnitus and no one effective treatment. Most treatments aim to help patients habituate to tinnitus.

What is tinnitus?

Tinnitus is the perception of sound within the ear or head, without a corresponding external stimulus for that sound. Tinnitus may be described as a buzzing, ringing, roaring, clicking, booming, hissing, whistling or cicada-like noise. It can be heard as a single sound or as a complex mix of different sounds. It can be unilateral or bilateral, of sudden or gradual onset, constant or intermittent, and with fluctuating pitch and intensity. Its characteristics tend to reflect associated pathology and hearing loss. Approximately 40% of people with tinnitus are also intolerant to the loudness of everyday sounds.¹ When this intolerance is severe it is referred to as hyperacusis.

Tinnitus can be subjective (approximately 95% of cases) or, less commonly, objective (approximately 5% of cases).² Subjective tinnitus can arise because of problems in any part of the ear and auditory pathways. It may also arise or be modulated because of problems in the skin and muscles of the head and neck and their sensory pathways.

Objective tinnitus is generated by musculoskeletal and vascular structures that are in close proximity to the cochlea. The "somato-sounds" (body noises) produced by these structures are often vibratory or pulsatile and perceived by patients as originating within the ear – in some people they are (see "Objective vs. subjective tinnitus", page 31).

Clinically significant tinnitus can be defined as noises in the ear or head lasting for more than five minutes and occurring more

than once per week.³ An alternative definition is: "tinnitus that bothers people, affects their life and causes them to frequently seek professional help".⁴

Transient tinnitus (i.e. lasting for less than five minutes) is a common occurrence after exposure to loud sounds such as an explosion or after a music concert. It may also be associated with transient hearing loss and is significant because of the risk of permanent damage.

The incidence of tinnitus

It has been estimated that at least 15% of adults will experience tinnitus during their lifetime.^{3, 6} For the majority of people, symptoms are mild and brief. However, in approximately 1 – 2% of people (some studies report as much as 5%), tinnitus is severe, on-going and causes significant distress.^{5, 6}

Risk factors for tinnitus include:

- Increasing age – peak incidence is in people in their 60's, after which the incidence of distressing tinnitus declines again, although tinnitus can occur at any age⁷
- Hearing loss – approximately 80% of people with tinnitus have some degree of hearing loss, although the prevalence varies with age (67% of those aged 16 – 48 years, and up to 86% of those aged 64 – 95 years).⁶ There is little correlation between the degree of hearing loss and the severity of the tinnitus.

- Exposure to loud noise – occupational and recreational noise exposure is associated with the development of tinnitus and is often accompanied by noise-induced hearing loss.⁷ Exposure to loud noise causes injury to the cochlea, in particular the outer hair cells which may be permanently damaged.⁸
- Smoking and hypertension – there is some evidence that vascular disease may be a factor in the development of tinnitus⁷

The majority of studies report that more **males** are affected by tinnitus than females.^{5,7}

There are well established associations between tinnitus and **mental health disorders**, such as depression and anxiety.² People with tinnitus frequently report sleep disturbance, decreased productivity at work, increased stress levels, inability to concentrate and feelings of annoyance or frustration, and that these factors contribute further to their psychological distress.^{2,7,9} There is on-going debate in the literature as to the extent to which tinnitus causes anxiety and depression or if it is more common in people with these conditions.⁵

It has been proposed that the tendency for an individual to be aware of tinnitus and for it to be persistent may be influenced by their **personality type**. People who experience tinnitus may tend to be less social, less self-controlled and more negatively emotional than people without tinnitus.¹⁰ Parallels are often drawn between people with tinnitus and those with

chronic pain.^{11,12} There are similarities in the physiological and psychological factors that initiate and perpetuate these complex conditions and also similarities in the impact that the conditions have on the life of people with them.¹²

Management of tinnitus begins at the first consultation

Tinnitus is a symptom, not a specific diagnosis. In the majority of people, no specific pathological cause is found and tinnitus is therefore considered to be subjective and neurophysiological (idiopathic).^{3,5} However, there are multiple conditions which contribute to the presence of tinnitus (Table 1) and it is important to identify them.

The aim of the history and clinical examination is not only to determine if there is an identifiable cause for the tinnitus, but also to “set the scene” for ongoing management. Reassurance and support are important to avoid inadvertently increasing anxiety, fear or anger.^{11,15} Making negative statements to patients such as “there is nothing that can be done” or “you have to learn to live with it” are untrue and may result in an increased focus on tinnitus and therefore an exacerbation of the distress that it causes.^{3,11} Tinnitus can interfere with a person’s ability to perform at work and cause significant difficulties with family and social interactions. The consequences of tinnitus can therefore be very distressing for patients and may include feelings of frustration, a sense of isolation, low mood or depression and in severe situations suicidal thoughts.¹¹

Table 1: Possible causes of tinnitus^{13,14}

Conditions that cause tinnitus by affecting the middle or inner ear and its function	Conditions that cause tinnitus by a direct or indirect effect on the auditory pathway	Other causes of objective tinnitus
<ul style="list-style-type: none"> ■ Wax build-up in the ear canal ■ Chronic otitis externa ■ Chronic otitis media ■ Perforation of the tympanic membrane ■ Otosclerosis ■ Ménière's disease ■ Noise ■ Trauma to the ear ■ Medicines such as aminoglycoside antibiotics, loop diuretics and aspirin in excess 	<ul style="list-style-type: none"> ■ Multiple sclerosis ■ Cerebellopontine angle tumour (acoustic neuroma) ■ Meningioma ■ Intracranial pathology, e.g. stroke or tumour ■ Trauma to the head or neck ■ Temporomandibular joint disorders ■ Hypertension ■ Hypo- or hyperthyroid disease ■ Hyperlipidaemia ■ Hyperinsulinaemia and diabetes ■ Vitamin B12 deficiency 	<ul style="list-style-type: none"> ■ Vascular – an arterial bruit, arteriovenous malformation, vascular tumour ■ Neurological – spasm of the stapedial muscle, palatomyoclonus ■ A patent (patulous) eustachian tube

When taking a history:

Ask the patient to describe the **characteristics of the tinnitus**. Is it pulsatile? Unilateral or bilateral? Constant or intermittent? And if intermittent, how often and for how long does it persist? Pulsatile tinnitus is usually indicative of objective tinnitus. If tinnitus is unilateral it is more likely to be caused by underlying pathology, and conversely, if it is bilateral it is more likely to be benign in origin. If the tinnitus is of shorter duration (months rather than years) there is a higher likelihood that it will improve over time. It should also be distinguished from an auditory hallucination, secondary to a psychotic disorder.

Ask if there are any **associated symptoms** including deafness, dizziness, vertigo, hyperacusis (intolerance of loud noises), a blocked sensation in the ear, otalgia or otorrhoea. Associated symptoms may point towards an underlying cause such as otalgia due to otitis media, episodic vertigo and deafness due to Ménière's disease, or unilateral sensorineural hearing loss and tinnitus in a patient with a cerebellopontine angle tumour.

Ask the patient if they are aware of **triggers** for the tinnitus. Is there a history of excessive noise exposure (occupational or recreational), a head or ear injury or an increase in stress?

Ask about the **impact on daily life**. How troublesome do they consider it to be? When did the tinnitus start to become annoying to them?

Ask if the tinnitus is disturbing the patient's **sleep or mood**. Does the patient have a history of psychological problems?

Consider a **review of medicines** – have there been any new medicines started, including any over-the-counter medicines? Are there existing medicines that could be implicated, e.g. excessive aspirin use? Has the patient been given any ototoxic medicines such as gentamicin during a hospital admission? (see: "Medicines that may cause tinnitus", over page).

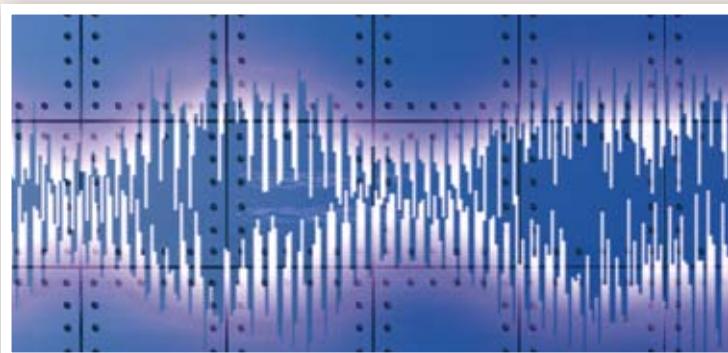
Consider the **age** of the patient – an older patient is more likely to have hearing impairment as the hair cells in the cochlea degenerate with age. This results in a decreased ability to hear higher pitched sounds. There is also some evidence that the distress associated with tinnitus is likely to be worse if it begins at an older age due to a reduction in neuroplasticity.⁶

Is there a **family history of hearing loss**?

Subjective vs. objective tinnitus

Subjective tinnitus is the most commonly experienced form of tinnitus. The tinnitus is only heard by the patient and is usually described as having a more continuous tone rather than being pulsatile. It has no acoustic source. Within the brain the primary auditory centres are normally receptive only to neural activity generated by external sound and transmitted from the inner ear through the classical auditory pathway. If the primary auditory centres become aware of other neural activity, this is interpreted as noise and the patient perceives it as tinnitus. Hearing impairment reduces the influence of the classical auditory pathway. Neural activity which is normally suppressed is processed unconsciously, reinforced by negative emotional influences, detected by the primary hearing centres and interpreted as tinnitus. In the presence of negative emotional associations, a positive feedback loop is generated and there is increased perception of the signal which becomes subjectively louder, more intrusive, more annoying and persistent.⁵

Objective tinnitus is produced by an internal acoustic stimulus from a physiological (often referred to as somatic) source which can include both auditory and non-auditory structures. The eustachian tube may produce an audible click as it opens and closes. Muscles within the middle ear or of the soft palate may fasciculate. Arterial pulsation or a venous hum may be generated by vascular tumours or abnormalities in or close to the ear. Objective tinnitus may be audible on examination using a stethoscope placed on the head in sites around the ear or over the carotid arteries. Obstructing wax in the ear canal and other causes of conductive hearing loss may make any of these somato-sounds more audible to the patient.



Medicines that may cause tinnitus

Medicine group	Effect
Aspirin, NSAIDs and quinine	Can cause reversible, multifactorial impairment of hair cell function
Loop diuretics, e.g. frusemide	Can cause reversible and dose dependent changes in electrolyte balance in the cells of the inner ear
Aminoglycoside and macrolide antibiotics, e.g. neomycin, framycetin, gentamicin and erythromycin	Irreversibly ototoxic to the hair cells of the cochlea and vestibular system, including after excessive topical application (e.g. with the use of ear drops that contain these antibiotics – sofradex, soframycin, kenacomb)
Antimitotic drugs, e.g. methotrexate, cisplatin, vincristine	Ototoxic – can cause tinnitus and sensorineural hearing loss, which can be permanent

On examination it is important to check the:

- **Ears** – to exclude a build up of wax, infection of the canal or middle ear, tympanic membrane perforation or the presence of a foreign body, e.g. a hearing aid battery or an insect (see: "It sounds like there is a bug in my ear!"). Tympanometry provides information about the mobility of the tympanic membrane and eustachian tube function.
- **Blood pressure** – hypertension has been associated with tinnitus
- **Neck and temporomandibular joints** – for tenderness and crepitus as musculoskeletal problems in either may produce somatosensory tinnitus
- **Auscultation** – listen for carotid bruits and also over the skull around the ears for the presence of tinnitus from non-auditory structures
- **Cranial nerves** – a focused neurological examination is required if there are symptoms to suggest an underlying neurological condition. For example, a facial palsy and reduced corneal reflex may be present in patients with cerebellopontine angle tumours.

Check for hearing loss

Initial tests to screen for hearing loss can be carried out in primary care. Test the patient using a soft whisper or rub their hair between your fingers just behind their ear. Weber and Rinné tests using a tuning fork (see: "How to perform tuning fork tests", Page 34) can help distinguish between a sensorineural (e.g. damage to cochlea or cochlear nerve) or conductive (e.g. blocked ear canal, middle ear effusion) hearing loss.

 Applications are now available via some smart phones that can check for sensorineural hearing loss, e.g. "Action on hearing loss" free iPhone hearing check (Search App Store, keyword: deafness or hearing check).

Diagnosing the cause of tinnitus

An algorithm incorporating the characteristics, frequency and site of tinnitus can be helpful in determining the cause (Figure 1). In some cases, referral for further investigations such as MRI is required to make a specific diagnosis.

Manage any underlying conditions

If the cause of tinnitus is found to be an underlying condition that is treatable in primary care, e.g. wax build up, infection, appropriate management of the underlying condition should alleviate the tinnitus.

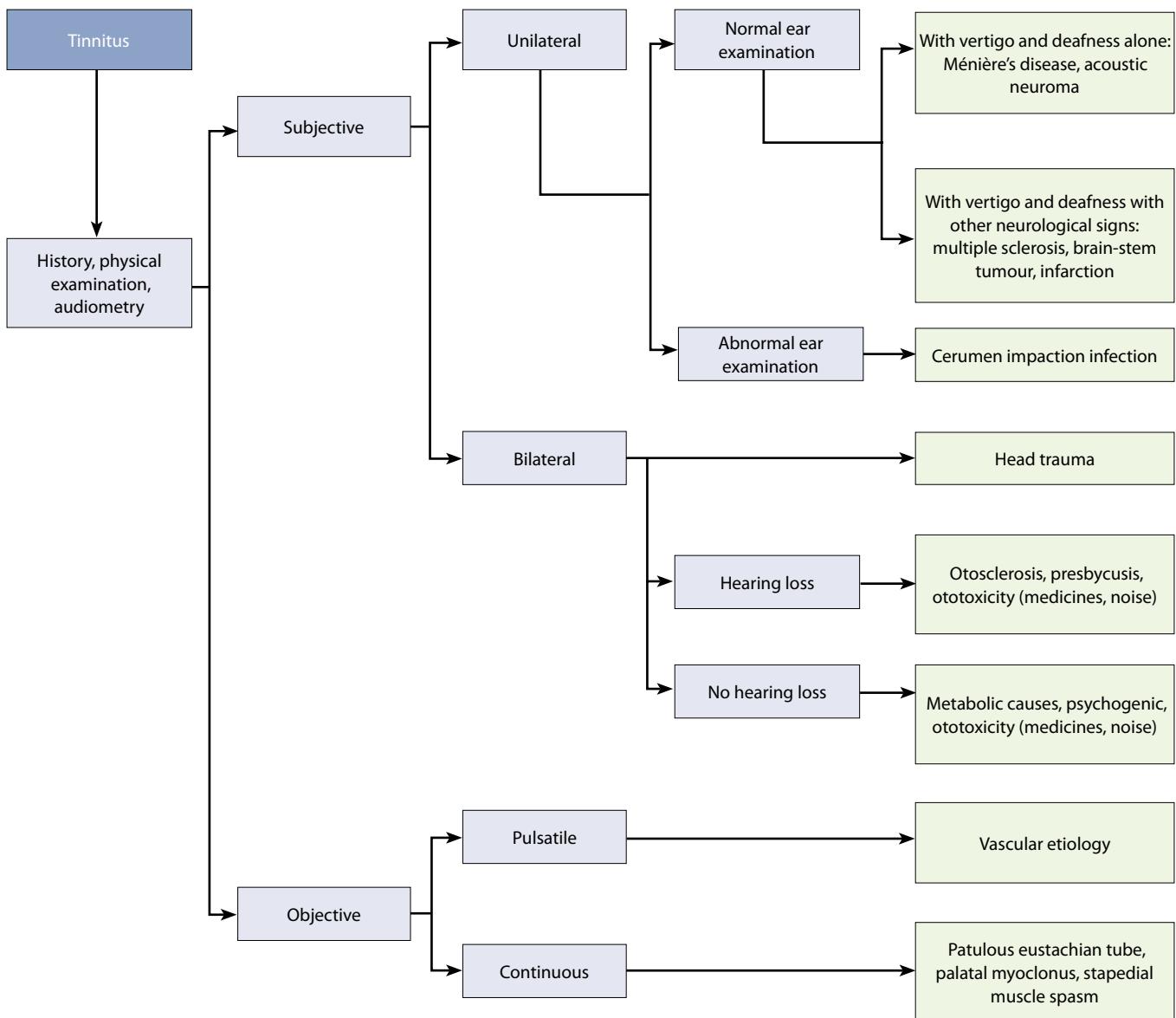


Figure 1: Diagnostic algorithm for tinnitus adapted from Crummer, 2004¹³

A referral for audiology is recommended for all patients with clinically significant tinnitus once ear wax and infection have been excluded.^{15, 16} Treatment of hearing loss with a hearing aid often improves tinnitus (Page 34).

Referral to an otolaryngologist is required if tinnitus is:^{11, 17}

- Unilateral
- Pulsatile
- Rapidly progressive
- Associated with sudden hearing loss or fluctuating hearing, fullness or pressure in one or both ears, vertigo or disturbed balance
- Persistent, troublesome and intrusive

These features may indicate an otologic disease such as Ménière's disease, cholesteatoma or a cerebellopontine angle tumour.

Although a rare cause of tinnitus, if an underlying metabolic condition is suspected, laboratory testing may be indicated, e.g. TSH for hypo- or hyperthyroidism, HbA_{1c} for diabetes, FBC for anaemia or infection.

How to perform tuning fork tests

Weber test

Hit the tuning fork lightly on your knee, elbow or firm surface and hold the base on the patient's forehead. If the sound cannot be heard, gently try the bony part of the nose or the middle of the two front teeth. Ask the patient where they hear the sound the best.

In a normal test, or in a patient with a symmetrical hearing loss (e.g. in an older person with age related hearing loss) the sound is heard equally in both ears or in the midline. In an abnormal test, the sound is heard better in one ear than the other. If there is sensorineural hearing loss the sound will be louder in the normal ear. If there is conductive hearing loss the sound is heard better in the ear with the problem. One way to help remember this is to give yourself a conductive hearing loss by blocking one ear with your finger and then speaking or humming - the sound is louder on the side that is blocked, i.e. that has the conductive hearing loss.

Rinné test*

Hold the base of the vibrating tuning fork on the patient's mastoid process. When the patient can no longer hear the sound, move the tuning fork to the ear and ask if they can hear the sound again.

A normal result is when the sound is heard again – air conduction is greater than bone conduction. An abnormal result is when the sound cannot be heard again – bone conduction is greater than air conduction, i.e. there is a conductive hearing loss in that ear, particularly if the Weber test lateralises to that side as well.

In some people with severe asymmetric hearing loss, the Rinné test may appear to be normal because the unaffected opposite ear will detect the sound by air conduction. If you "mask" this ear by making a competing sound, this should be avoided.

* There are various methods

Management of subjective neurophysiological tinnitus

There is no cure and no one specific treatment that is effective for subjective, neurophysiological (idiopathic) tinnitus.^{3, 5} Most treatments are aimed at trying to reduce the intensity of tinnitus or to reduce the annoyance and distress that accompanies it.²

Patients with bilateral tinnitus, with no impairment of hearing and who report that it is not troublesome usually do not need referral for any further investigations or treatment. Explanation and reassurance is often sufficient and referral should generally be avoided so that the patient does not focus their attention on tinnitus.¹⁷

Provide education and reassurance

Explain to the patient what tinnitus is and how it may be triggered and influenced by many factors, including hearing impairment, jaw and neck problems, stress, depression and other emotional associations. Aim to improve the patient's understanding of their tinnitus so that they are more able to focus on actual sounds rather than the neural activity they perceive as tinnitus. Provide suggestions for improving desirable sound stimulation, reducing aggravating stimulation from the neck and jaw and disassociating emotional factors.



Local support groups and advice can be found at:
www.tinnitus.org.nz

Review medicines and continuing noise exposure

Where appropriate, medicines which cause tinnitus can be identified and withdrawn. If there is ongoing exposure to excessive noise, advice can be given about hearing conservation and protection.

Consider referral for hearing aids in patients with hearing loss

Straining to hear causes an increase in the sensitivity of the central auditory systems and can allow tinnitus to emerge or, if already present, to worsen.¹⁸ The correction of any associated hearing loss reduces this sensitivity and will also usually help the patient to focus on environmental sounds rather than on the tinnitus. Hearing aids are often useful in patients with tinnitus even if the hearing loss is relatively mild and would not on its own make a hearing aid appropriate.¹⁸ Some people benefit from combination devices – hearing aids which also function as sound generators.

Habituation

Habituation is the ability of a person to become less aware of their tinnitus, and when they are aware of their tinnitus, to avoid associating it with anxiety or distress.¹⁶ The brain can be “trained” to pay less attention to tinnitus in a similar way that people who live next to a busy road can “tune out” the noise of the traffic. It is likely that habituation is part of the natural history of tinnitus, but in some people the process of habituation fails to occur, often when there is a negative emotional significance attached to the tinnitus. This results in the person paying selective attention to tinnitus and beginning a vicious cycle. It has been said that “the difference between a person who experiences tinnitus and one who ‘suffers’ from it may be the person’s ability to habituate to the tinnitus.”¹⁶

Stress reduction

Tinnitus is often associated with stress although it is not always clear whether the stress has exacerbated the tinnitus or tinnitus worsened the stress. In the majority of patients, reassurance and general advice on stress reduction and management will be beneficial.

Promote good sleep hygiene

Tinnitus often disturbs sleep and the tiredness that results may then compound the problem. Encourage good sleep hygiene. Sound enrichment (see below) at night may also be helpful.

Sound enrichment

Many people with tinnitus seek quietness in an attempt to gain relief from the noise of their tinnitus. However, they should be advised to avoid environments that are too quiet because this gives them nothing to listen to except tinnitus.

In many patients, particularly those who have hearing loss, quietness may increase the sensitivity of the auditory system and this worsens the tinnitus. The use of sounds that reduce the ratio of tinnitus to other environment noises can be useful and provide an alternative focus. Encourage the patient to play music, have the radio or television on in the background or even turn on a fan. The noise of a water feature or the use of relaxation tapes may be helpful as may electronic sound generators and maskers.

Distraction

Distraction with day to day activities (leisure or work) and regular exercise can be effective.

Dietary triggers

There is anecdotal evidence that for some people excess consumption of caffeine containing foods and drinks, high salt foods and quinine in tonic water may worsen tinnitus. However, there is no robust evidence on whether reducing the intake of these decreases the severity of tinnitus.

Psychological approaches

Cognitive behavioural therapy (CBT) and tinnitus retraining therapy (TRT) combine educational and psychological components, with the aim of achieving habituation by enhancing coping strategies, improving quality of life and assisting people to manage their tinnitus more effectively. Although evidence regarding the effectiveness of these approaches is limited, a recent randomised controlled trial has shown a significant improvement in quality of life for patients and a reduction in the severity of and impairment from tinnitus.



"It sounds like there is a bug in my ear!"

A live insect in the ear canal may produce noises that are described in a similar way to tinnitus. A history of a sudden onset of ear noises, often accompanied by pruritus, pain or nausea may suggest the presence of a live insect. Examination of the ear will usually confirm the diagnosis. Provided there is no perforation of the tympanic membrane, irrigation is the simplest way to remove the insect, although, if available, suction removal is recommended, especially if there is suspicion of perforation. If the insect is easily seen and the patient is able to lie still, it may be possible to carefully extract the insect under direct vision with a Tilley forceps. The insect should be killed first using 2% lignocaine, a mineral oil (e.g. baby oil) or emla cream.

using an approach that combines elements of both CBT and TRT.¹⁹ CBT is available through clinical psychologists and TRT through many audiologists.

Pharmacological treatment

The evidence to support the use of pharmacological treatments for tinnitus is inconclusive. Medicines may be appropriate if used to treat conditions associated with tinnitus, e.g. antidepressants in patients who also have anxiety or depression.⁵ Both tricyclic antidepressants and SSRIs, along with medicines such as anticonvulsants (e.g. gabapentin and carbamazepine) and benzodiazepines (short-term use) may be trialled in individual patients depending on their circumstances (e.g. the presence of excessive anxiety or insomnia), however, there is anecdotal evidence that suggests that repeated attempts using unsuccessful pharmacological treatments may worsen tinnitus.¹⁸

Complementary treatments

A number of complementary treatments, including acupuncture, aromatherapy, hyperbaric oxygen therapy, ginkgo biloba, homeopathy and reflexology have been used to try to reduce symptoms of tinnitus. There is no robust evidence that any of these treatments is effective.^{5, 20, 21}

Treatments available in secondary care

Intratympanic administration of gentamicin or steroids, or the use of intratympanic or intravenous lignocaine, may be of value for patients who have tinnitus due to Ménière's disease.

Cochlear implants have been found to reduce tinnitus in some patients who have severe or profound bilateral hearing loss.

Repetitive transcranial magnetic stimulation (rTMS) uses a device to generate a brief magnetic field which when held against the scalp produces a weak electric current in the underlying tissues.²² The hyper-excitability in the auditory cortex associated with tinnitus is suppressed by rTMS. There is some evidence that it may be helpful in patients with moderate tinnitus that has been present for less than four years.²²

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