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ABC of Ear, Nose and Throat, 6th Edition

Tinnitus

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Overview

Approximately 10% of the UK population is affected by tinnitus

Of vestibular schwannomas (acoustic neuromas), 13% present with unilateral tinnitus and have normal hearing

Pulsatile tinnitus should be fully investigated as it may be a symptom of a cardiovascular disorder

There are several methods designed to alleviate the distress associated with tinnitus

Tinnitus is defined as the aberrant perception of sound without any external stimulation. Tinnitus may be described as either subjective or objective. Subjective tinnitus, the most common type, occurs in the absence of any physical sound reaching the ear and is audible only to the patient. Objective tinnitus, which affects a minority of patients (1%), is generated in the body and reaches the ear through conduction in body tissue and is audible to the patient as well as the clinician (also referred to as somatosounds).

Epidemiology of Tinnitus

Most people experience transient tinnitus at some time or other, particularly following exposure to loud noise. Prolonged tinnitus is experienced by approximately 10% of the adult UK population and in approximately 1% of adults, the severity of the tinnitus may severely affect their quality of life (Figure 1). Prevalence increases with age, although tinnitus is also commonly reported in children.

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Figure 1

Tinnitus can have a serious impact on the quality of life.

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Clinical Presentation

Tinnitus may be audible in one ear, both ears or in the head, and some people describe it as emanating from outside the head. Most patients report an increased awareness of tinnitus in quiet surroundings. It consists of an intermittent or continuous rushing, ringing, hissing or buzzing noise and it may be low, medium or high-pitched. The location and severity of tinnitus is not predictive of the distress experienced by the patient. Tinnitus is also commonly associated with hyperacusis, which is characterised by a reduced tolerance to sounds at levels which would not cause discomfort in normal individuals.

Otological Causes of Subjective Tinnitus

Tinnitus is frequently associated with hearing loss (Box 1) which may be conductive, sensorineural or mixed, but may also occur in individuals with normal or near-normal hearing. Hearing loss resulting from noise exposure and prebyacusis is frequently associated with tinnitus. Tinnitus may also be a feature of specific diseases such as Menière's disease. Rarely, unilateral tinnitus may be the only symptom of a vestibular schwannoma.

Pathological Conditions Associated with Tinnitus

Chronic noise exposure

Presbyacusis

Acute acoustic trauma

Perforation of the tympanic membrane

Otitis media

Menière's disease

Vestibular schwannoma, meningioma

Ototoxic drugs

Whiplash injury/cochlear concussion

RETURN TO TEXT

Subjective Tinnitus and Other Medical Conditions

Medical conditions associated with tinnitus include metal (zinc) or vitamin deficiencies, cardiovascular disorders such as a stroke, metabolic disorders such as diabetes, thyroid disease and hyperlipidaemia, and neurological disorders such as multiple sclerosis, head injuries, whiplash injuries or meningitis.

Tinnitus may also occur as a complication of certain ototoxic drugs such as non-steroidal anti-inflammatories (NSAIDs), salicylates, quinine, aminoglycosides, loop diuretics and antineoplastic drugs such as cisplatin. The ototoxic effects of NSAIDs, salicylates and quinine are dose dependent, occur at high doses and are generally reversible. Although the ototoxic effects of aminoglycosides and chemotherapeutic agents such as cisplatin are dose dependent, they can also be ototoxic at therapeutic levels, and cause permanent cochlear damage.

Other medical causes include autoimmune inner ear disease and neoplastic conditions such as a vestibular schwannoma or a meningioma.

There is a high co-morbidity between clinically significant tinnitus and anxiety and depression. Furthermore, subjects with both tinnitus and depression tend to report more severe tinnitus than those without depression.

Objective Tinnitus

If the patient complains of pulsatile tinnitus, the clinician should conduct an extensive search for a skull base tumour or a vascular abnormality. There are numerous vascular causes of pulsatile tinnitus (Box 2); the most common being arteriovenous malformations (AVM) and fistulas. Carotid abnormalities such as atherosclerosis and aneurysms can also cause pulsatile tinnitus. Additional causes include an aberrant carotid artery, a high-riding jugular bulb and a glomus tumour. A glomus tumour may present as a red hue behind the tympanic membrane which blanches with positive pressure on carrying out pneumatic otoscopy.

Causes of Objective Tinnitus

High cardiac output

Benign intracranial hypertension

Dural or extracranial AV fistula

Carotid or vertebral artery stenosis, tortuosity, dissection or aneurysm

Aortic stenosis and mitral regurgitation

Dural or cervical AVM

High jugular bulb

Vestibular schwannoma

Temporomandibular joint syndrome

Haemangioma

Glomus tumour

Otosclerosis

Paget's disease

RETURN TO TEXT

Benign intracranial hypertension has been reported as a major cause of pulsatile tinnitus in young women. This can be identified by papilloedema on fundoscopic examination. Systemic causes of pulsatile tinnitus include a hyperdynamic circulation due to treatment of hypertension with angiotensin converting enzyme inhibitors or calcium channel blockers. Paget's disease and otosclerosis can also cause pulsatile tinnitus, considered to be due to the neovascularisation of new bone formation, deposition and reformation.

Other causes of objective non-pulsatile tinnitus include middle ear and palatal myoclonus. Middle ear myoclonus results from activity of the stapedius and tensor tympani muscles. The sound is described as a rhythmic clicking or buzzing which is usually unilateral. Involuntary movements of the soft palate (palatal myoclonus) can cause a “clicking” tinnitus.

Pathophysiology

A useful distinction has recently been made between the ignition site of tinnitus and

the mechanisms that promote the signal within the central auditory pathways. The ignition point has been defined as the site that first shows an increase in spontaneous firing rates (SFR) and is the most peripheral to do so. The site is thought to vary depending on the aetiology of the tinnitus, for example salicylate-induced tinnitus may have an ignition site within the cochlea or cochlear nerve with increased SFR within the auditory nerve fibres. Tinnitus evoked by somatic modulation such as teeth clenching may have an ignition site in the dorsal cochlear nucleus where inputs from the somatosensory system and auditory systems interact.

The physiological mechanisms responsible for tinnitus within the central auditory pathways include an increase in spontaneous discharge rates, an imbalance between excitation and inhibition with a release of excitatory inputs and reorganisation of the central auditory pathways.

Clinical Assessment

There are no known objective tests that can determine the severity of subjective tinnitus.

A detailed case history is important to determine the type and characteristics of tinnitus: for example pulsatile or non-pulsatile, unilateral, bilateral or in the head, intermittent or continuous and masking by environmental noise. One should enquire about the onset, duration and potential causal relationship and trigger mechanisms such as previous noise exposure, associated hearing difficulties, hyperacusis and history of vertigo. The clinician should also enquire about the occupational status of the patient and establish how much trouble the patient is having in terms of sleep disturbance, impaired concentration, psychoemotional and psychosocial issues, as this will dictate whether and how much treatment is necessary.

Clinical Examination and Investigations

The following examination and investigations are suggested.

- Otoscopy (Figure 2)
- Tuning fork tests to uncover a conductive or sensorineural hearing loss (Figure 3)
- Auscultation of the ear canal, preauricular and postauricular regions, orbit and

neck for a carotid bruit, jugular venous hum, AVM thrill or myoclonic clicks (Figure 4)

- Palpation of the temporomandibular joint (TMJ) and examination of the dentition and occlusion
- Observation of the palate for palatal myoclonus
- Fundoscopy may identify the papilledema of benign intracranial hypertension
- Tympanometry for evidence of glue ear, perforation of the tympanic membrane or myoclonic activity
- Pure tone audiometry is essential to document any hearing loss (Figure 5)
- Otoacoustic emissions to obtain additional information on cochlear and efferent function
- Auditory brainstem evoked responses may indicate retrocochlear pathology in subjects with asymmetrical tinnitus
- Tinnitus pitch and loudness matching may be performed. Usually the pitch of the tinnitus is found to be at or around the frequency of the maximal hearing loss and the loudness is usually within 15dB of the patient's pure tone threshold at that frequency
- Uncomfortable loudness levels are useful if there is any coexistent hyperacusis
- Medical evaluation in some patients including, full blood count, blood glucose, urea and electrolytes, thyroid function tests and lipids
- MRI is recommended in the presence of asymmetrical tinnitus or hearing loss as 13% of vestibular schwannomas present with asymmetrical tinnitus and normal hearing
- Pulsatile tinnitus may require CT or MR angiography. If the source of tinnitus is not identified on CT or MR angiography and a bruit is heard on auscultation, carotid angiography may be required.

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Figure 2

Otological examination is essential in the evaluation of tinnitus.

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Figure 3

A tuning fork is used for the diagnosis of a conductive or a sensorineural hearing loss.

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Figure 4

Auscultation of the neck may demonstrate cervical bruits and hums arising from cervical arteries or veins.

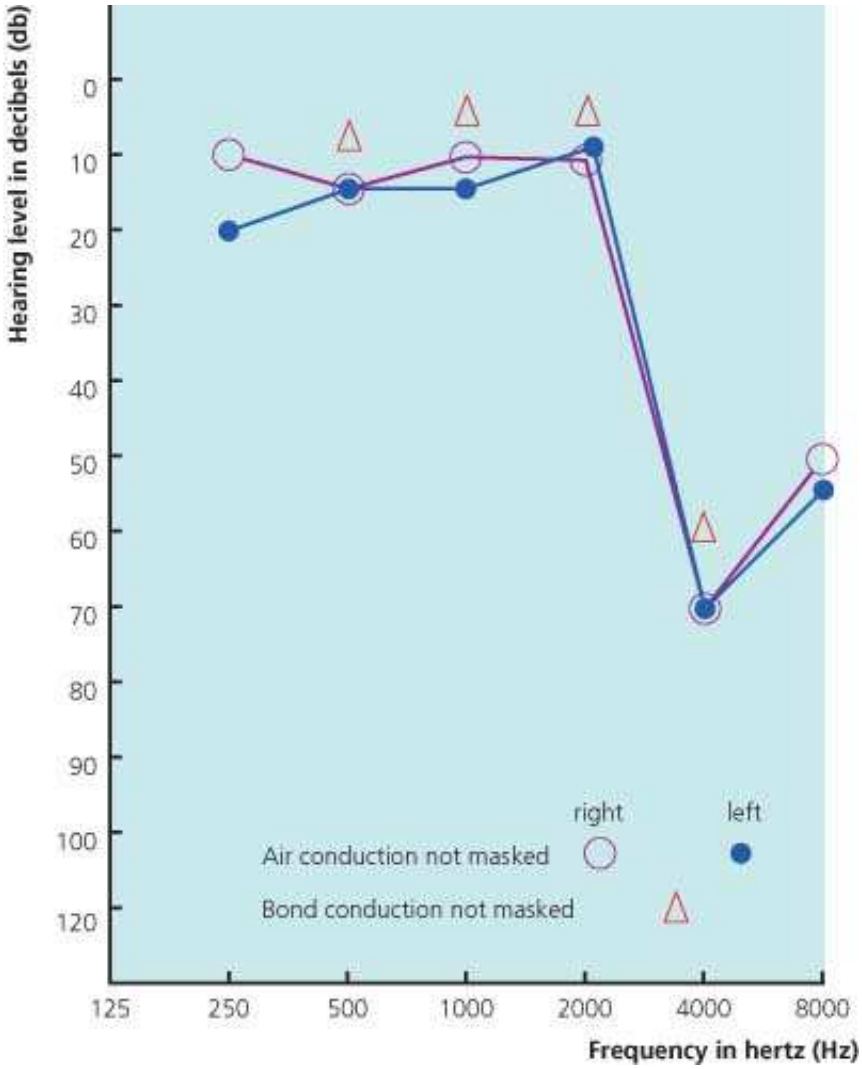

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Figure 5
Pure tone audiogram showing a sensorineural hearing loss.

Management

There is a common belief that tinnitus is incurable or untreatable and therefore only a small number of patients (1%) contact physicians or hearing care professionals for help despite its high prevalence. Yet, there are several methods of tinnitus management designed to alleviate the distress associated with tinnitus. Management is best undertaken by a multidisciplinary team comprising an audiovestibular physician or an otolaryngologist, a hearing therapist, an audiologist and a clinical psychologist. Dental treatment or bite realignment can help relieve TMJ pain and associated tinnitus.

Cognitive Behavioural Therapy

Cognitive behavioural therapy (CBT) is used to identify and alter negative behaviour and thought patterns. The focus of cognitive therapy is on the interpretation that people place upon events rather than the events themselves. If tinnitus per se caused psychological distress, then everyone experiencing tinnitus would experience similar psychological distress, which is clearly untrue. Whereas some patients with tinnitus feel that it indicates the presence of a catastrophic illness, others interpret it as a feature of aging and some patients see their tinnitus in a more positive light. CBT addresses the negative distorted beliefs which surround tinnitus and helps the patient to use structured thinking that results in less anxiety. CBT is believed to be an effective treatment for tinnitus.

Tinnitus Retraining Therapy (TRT)

Tinnitus retraining therapy (TRT) is designed to help a person retrain the brain to avoid thinking about tinnitus. It uses a combination of counselling together with a non-masking white noise which decreases the contrast between tinnitus and the surrounding environment. Randomised, controlled clinical studies with no treatment and placebo groups are required to ascertain the effectiveness of TRT for the treatment of tinnitus.

Sound Therapies

Virtually all sound therapies are combined with some form of counselling. Many tinnitus sufferers get relief from listening to background sounds, such as distant traffic, wind in the trees or waves breaking on the seashore. These sounds can be generated through hearing aids (Figure 6) and sound globes. Sound globes (Figure 7) are portable devices which sit on the bedside/tabletop and provide a variety of soothing sounds.

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Figure 6

Hearing aid.

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Figure 7

Combination aromatherapy and sound relaxation device.

Patients with insomnia due to tinnitus may benefit from a pillow speaker (Figures 8 and 9) or a radio with a time switch. Some sound generators and most compact disc players, mp3 players, etc., can be plugged into a pillow speaker.

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Figure 8
Pillow speaker.

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Figure 9

Pillow speaker can be attached to an mp3 player.

Hearing Aids

Hearing aids are used increasingly to treat patients with tinnitus. Digital hearing aids seem to alleviate tinnitus more effectively than analogue aids as they can selectively amplify the high frequencies at which tinnitus usually occurs and can also be used for patients with minimal hearing losses, unlike analogue aids.

White Noise Generators

Masking devices were introduced because patients observed that their tinnitus was more pronounced in quiet surroundings. Current white noise generators are used to obscure rather than obliterate the tinnitus, by producing a gentle rushing sound. The obliteration of tinnitus is seen as being counterproductive in terms of the habituation process, as one cannot habituate to tinnitus which is not audible due to masking. White noise generators are worn behind the ear or in the ear (Figure 10). If the patient has a hearing loss as well as tinnitus, the masker and the hearing aid may operate together as one instrument.

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Figure 10

Tinnitus white noise generator.

Neuromonics

Neuromonics, developed in Australia, combines acoustic stimulation with a structured programme of counselling and support by a clinician skilled in tinnitus rehabilitation. In neuromonics, the audiologist matches the frequency spectrum of the tinnitus to music which overlaps the sound spectrum of the tinnitus. The music stimulates the auditory pathways deprived by hearing loss and engages the limbic system and the autonomic nervous system.

Biofeedback

Biofeedback is a relaxation technique that teaches people to control certain autonomic body functions, such as pulse, muscle tension, and skin temperature. The goal of biofeedback is to help people manage stress, resulting in a reduction in the severity of tinnitus.

Pharmacological Treatment

Currently, no pharmacological agent has been shown to cure or consistently alleviate tinnitus. However, some drugs have been shown to be partially effective in some groups of patients (such as zinc in patients with zinc deficiency and selective serotonin re-uptake inhibitors (e.g. Sertraline) in depression). Large clinical trials for promising new treatments are currently underway.

Surgery

Surgery may be indicated in certain otological causes of tinnitus such as vestibular schwannomas, otitis media, perilymph fistulas and otosclerosis.

Further Reading

1. *American tinnitus association website. http://www.ata.org.*

2. *British tinnitus association website. www.tinnitus.org.uk.*

3. *Folmer RL, Griest SE, Meikle MB, Martin WH. Tinnitus severity, loudness, and depression. Otolaryngol Head Neck Surg 1999;121(1):48–51.*
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4. *Møller AR, Langguth B, DeRidder D, Kleinjung T. Textbook of Tinnitus, Springer, 2010.*

5. *Tyler RE. Tinnitus handbook, Singular, 2000.*