

A patient with tinnitus

Lloyd, S.K.W. & Baguley, D.M.

Department of Otolaryngology, Addenbrooke's Hospital, Cambridge, UK

A 56-year-old female comes to out patients with a 1 year history of bilateral tinnitus which occasionally makes it difficult for her to sleep.

What should you cover in the history?

Tinnitus is defined as the perception of a sound that is generated involuntarily within the head of an individual.¹ It is a very common condition with a prevalence in the adult population of around 10%.² However, the proportion of individuals with troublesome tinnitus is significantly less than this.

The majority of patients with tinnitus do not have any identifiable underlying pathology except for age-related sensorineural hearing loss. There are however, a number of specific conditions which can cause tinnitus and it is important to rule out their presence (Table 1). Many of these specific conditions can be diagnosed from the patient's history and examination and from simple audiological testing.

- *Ask about the character of the tinnitus.* Are the symptoms bilateral or unilateral? Unilateral symptoms raise the possibility of underlying organic pathology particularly a vestibular schwannoma. Precipitating factors such as noise exposure or trauma should be identified.

It is also important to elucidate whether the tinnitus is intermittent or constant.

- *The character of the tinnitus is important but very variable.* Ringing is the commonest type but others include whirring, hissing or a cricket-like sound.³ Complex sounds can occur and are often more troublesome than more simple sounds. Pulsatile tinnitus should raise suspicion of a vascular aetiology, for example carotid artery stenosis or (more controversially) a vascular loop within the internal auditory meatus.⁴ Clicking tinnitus may result from myoclonus of the stapedius, tensor tympani or palatal muscles.
- *Enquiries should be made regarding the intensity of the tinnitus* although the loudness does not necessarily relate to the impact that the tinnitus has on an individual's quality of life.
- *Ask about hyperacusis.* Once recruitment is excluded it appears that about 40% of patients with troublesome tinnitus also experience hyperacusis, wherein environmental sound of a moderate intensity is perceived as loud, intrusive and sometimes painful.
- *Ask about the impact that the tinnitus is having on quality of life.* The psychological impact that tinnitus is having on a patient is central to their management particularly in light of current neurophysiological and

Table 1. Some specific causes of tinnitus

Condition	Diagnosis
Conductive hearing loss	Ossicular erosion Ossicular fixation Otosclerosis Clinical examination and audiology
Neoplastic	Vestibular schwannoma Glomus jugulare MRI with DTPA-Gadolinium Clinical examination and imaging
Ototoxic drugs	Salicylates Aminoglycosides Loop diuretics History
Meniere's disease	History, audiology, electrocochleography
Vascular	Carotid artery stenosis Venous sinus stenosis IAM vascular loop Clinical examination and duplex ultrasound scan Angiography
Myoclonus	Stapedius Tensor tympani Palatal MRI+/- angiography History, clinical examination, tympanometry
Other	Benign intracranial hypertension History, clinical examination, MRI, lumbar puncture

psychological models of tinnitus. The situations in which the tinnitus is audible, the effect it has on sleep and the resultant effect on quality of life are the most important issues to discuss. There is good evidence that tinnitus induces sleep disturbance in 30–70% of individuals.⁵ However, it may be anxiety about the tinnitus rather than the tinnitus *per se* that results in insomnia. Depression and anxiety are reported in around 40% of tinnitus sufferers.⁶ In those with severe tinnitus, it is important to enquire about suicidal ideation although there is no strong evidence that tinnitus *per se* increases the risk of suicide. Rather, tinnitus may contribute to the depression and hopelessness that those considering suicide are experiencing.⁷

- *There are a number of grading systems to assess severity* but the most widely used is that described by Klockhoff and Lindblom. In their grading, grade I is tinnitus audible in silence only; grade II is tinnitus audible in ordinary noise but not loud environments; grade III is tinnitus audible in all acoustic environments, with disturbance of sleep and a reduction in quality of life.
- *Ask about associated otological symptoms.* All otological pathology can result in tinnitus, including conductive hearing loss. This may simply reflect a reduction in environmental auditory input, making any underlying tinnitus more prominent. For example, up to 40% of children with otitis media with effusion describe tinnitus if questioned.⁸ However, tinnitus is particularly common in patients with otosclerosis. This may reflect the reduction in environmental sounds, the increased vascularity of bone around the footplate and the presence of cochlear otosclerosis. The presence of vertigo or a sensorineural hearing loss in conjunction with tinnitus should raise the possibility of a vestibular schwannoma⁹ or Ménière's disease. The latter usually has a characteristic history. If headache or a postural variation in tinnitus intensity (classically an increase on lying down) is a significant feature of the history then benign intracranial hypertension should be considered. This is more common in women and in the obese.
- *Ask about any medications being taken.* Drugs causing tinnitus include salicylates, antibiotics including aminoglycosides and ciprofloxacin, anti-malarials such as quinine, loop diuretics such as furosemide, and cytotoxic agents such as cisplatin. The effects of aspirin and quinine are dose-specific and usually reversible. This contrasts with the effect of aminoglycosides which are not reversible.

What should you cover on examination?

As with the history the aim of examination is to assist in the exclusion of organic pathology.

- *Otoscopy.* Any external ear pathology resulting in a conductive hearing loss can cause tinnitus including occlusive wax, foreign bodies and otitis externa. Middle ear pathology that may cause tinnitus includes otitis media with effusion, chronic otitis media and middle ear tumours e.g. glomus tumours. In patients with otosclerosis it may occasionally be possible to observe the promontory blush that results in Schwarz's sign. In those patients with myoclonus, it may occasionally be possible to identify twitching of the tympanic membrane.
- *If there is a history of pulsatile tinnitus, it is important to auscultate the ear and the neck* as it may be possible to hear a bruit. Similarly, if myoclonus is suspected the palate should be examined to identify any palatal twitching.
- *Benign intracranial hypertension may be associated with papilloedema* and the fundi should therefore be examined if this condition is within the differential.

What management should you offer?

- *Pure tone audiogram.* The majority of people with idiopathic tinnitus have some degree of hearing loss, most commonly an age-related high frequency sensorineural hearing loss. It is important to identify any hearing impairment as this will have a bearing on future management. It will also identify those patients who have a conductive hearing loss that may be amenable to surgical intervention.
- *Impedance audiometry.* This is not necessary in the majority of patients but may be helpful in confirming the presence of a middle ear effusion. Stapedial reflexes have also been used historically in the diagnosis of otosclerosis although most surgeons do not use it as part of their routine practice in this situation. Impedance audiometry is useful in the diagnosis of stapedial and tensor tympani myoclonus. If the patient is experiencing myoclonus at the time of testing then a characteristic saw-tooth trace will be obtained.
- *MRI of the internal auditory meatus with gadolinium should be requested when vestibular schwannoma or a vascular loop is suspected.*
- *Other investigations.* If there is a carotid bruit then a duplex ultrasound of the carotid arteries should be arranged. If there is evidence of papilloedema then referral to a neurosurgeon for further assessment including a lumbar puncture to assess the intracranial pressure, should be made.
- *Any organic pathology should be managed on its own merits.* For the majority of patients with tinnitus, however, there is no obvious underlying pathology and

treatment is directed at reducing awareness of the tinnitus and its impact upon daily living. The underpinning aim is to induce habituation to the tinnitus.

- *Counselling is the mainstay of treatment.* The majority of patients are not sufficiently troubled to require specialist treatment. A careful explanation of the condition in order to provide the patient with a basic understanding of the auditory system and the mechanism by which tinnitus is generated demystifies the problem. The patient should also be strongly reassured that there is no underlying pathology. It is also helpful to explain that the anxiety resulting from the tinnitus is unfounded and will resolve. In addition, the patient should be told that the tinnitus should not be allowed to interfere with their life and that distraction often improves the tinnitus. Finally, there are a number of simple measures that may be helpful in reducing the impact of tinnitus, particularly at night. These involve the use of environmental sound to provide sound enrichment in order to mask the tinnitus e.g. a fan in the bedroom, use of soft music or an inexpensive digital environmental sound generator. These discussions take elements from the more in-depth and complex treatments of cognitive behavioural therapy and tinnitus retraining therapy discussed below.
- *Hearing aids are useful for those with tinnitus in association with a hearing impairment.* For those patients with significant hearing loss, provision of a hearing aid will rehabilitate hearing and may improve tinnitus by providing a degree of masking, and there is emergent evidence for their efficacy in this role.¹⁰ Open fit digital hearing aids widen candidacy for amplification for patients with mild or minimal hearing loss and may be particularly effective at inhibiting tinnitus.
- *Sound therapy may be useful where tinnitus has not responded to simple advice and (where appropriate) provision of a hearing aid.* Total masking of tinnitus delivered via an ear level masking device has been widely used and aims to make the tinnitus inaudible. However, finding the appropriate level of masking is often tedious and there is little evidence of benefit from this technique.¹¹ An alternative approach is to use an ear level wide band sound generator at a barely audible level to 'mix' with the tinnitus sound and facilitate habituation. This is a key element of retraining therapy (see below).
- *Medication has no role.* There are many studies investigating the role of medication in tinnitus management but unfortunately there are few randomised controlled trials. Medications that have been investigated include local anaesthetics, tricyclic antidepressants, selective serotonin reuptake inhibitors, benzodiazepines, baclofen, carbamazepine, betahistine and diuretics. None have shown any statistically significant benefit. A recent Cochrane review into the use of antidepressants in tinnitus showed no significant benefit and what benefit there is, is likely to be due to relief of distress associated with tinnitus rather than the tinnitus itself.¹² Intravenous lidocaine ameliorates tinnitus in 60% of patients but the effect is temporary as the drug has a short half-life. It also has significant cardiac and neurological side effects in overdose.¹³
- *Surgery should only rarely be considered.* Cochlear neurectomy has been advocated but is only successful in improving tinnitus in a minority of cases and in some may exacerbate the tinnitus. As a last resort, it should only be performed in the absence of useful hearing. Microvascular decompression for patients with vascular loops has been shown to improve tinnitus in around 50% of cases.¹⁴
- *Habituation based therapy is the mainstay of treatment for refractory tinnitus.* There are numerous theories regarding the possible aetiology of non-pathological tinnitus but it has become clear that concentrating on the underlying pathology is not particularly useful. Following an extensive review of current understanding of the auditory pathways and tinnitus mechanisms, Jastreboff has put forward a neurophysiological model for the origin of tinnitus on which modern tinnitus retraining therapy is based.¹⁵ Those with mild tinnitus are given counselling and advice regarding the use of environmental sounds for sound enrichment as described above. In addition to counselling, those with more severe tinnitus are given an ear level sound generator. If there is hearing loss present the patient is offered a combination device which consists of a sound generator and a hearing aid. The evidence base for the efficacy of this type of treatment is not strong and there are significant difficulties in performing placebo randomised controlled trials in counselling-based therapy. However, most studies show an improvement in tinnitus in the vast majority of patients.¹⁶ A Cochrane review of the literature is currently underway.
- *Cognitive behavioural therapy may be useful in selected refractory cases.* Cognitive behavioural therapy (CBT) is a psychological treatment designed to modify unhelpful beliefs and behaviours. As such, it aims to equip the patient with the ability to deal with their problem rather than addressing the symptom *per se*. In the case of tinnitus it aims to reduce the negative emotions that are associated with tinnitus and reduce the impact that the tinnitus has on the patient's psychological state. There is reasonable evidence that CBT has a positive

effect on the way in which people cope with tinnitus but there does not appear to be a demonstrable improvement in the subjective loudness of tinnitus, or in the depression associated with tinnitus.¹⁷

- *Complementary treatments are mostly not supported by evidence.* There are numerous complementary treatments that have been used in the management of tinnitus. There is some evidence that hypnosis may be helpful.¹⁸ Other therapies include homeopathy, acupuncture, ginkgo biloba and dietary supplements none of which are of any benefit according to current scientific evidence.
- *Patients may be directed towards self help groups.* Patients with troublesome tinnitus can be very distressed and seek more reassurance than is available in the ENT and Audiology clinics. Self help groups have a very important role to play here, and both the British Tinnitus Association (<http://www.tinnitus.org.uk>) and the American Tinnitus Association (<http://www.ata.org>) have well developed websites with professionally validated information.

Information sources

Current texts, the Cochrane library and other evidence-based databases were searched in the preparation of this paper. The current peer-reviewed literature was also searched using Medline under the MeSH heading 'tinnitus' and using subheadings for epidemiology, therapy, drug therapy and surgery. The search was limited to the English language, human studies and to clinical trials, randomised controlled trials and meta-analyses. The search was performed on 23 May 2007.

Conflict of interest

None to declare.

References

- 1 McFadden D. (1982) *Tinnitus. Facts, Theories and Treatments*. National Academy Press, Washington, DC

- 2 Davis A. & El Rafaie A. (2000) Epidemiology of tinnitus. In *Tinnitus Handbook*, Tyler R.S. (ed), pp. 1–23. Singular, Thomson Learning, San Diego, CA
- 3 Stouffer J.L. & Tyler R.S. (1990) Characterization of tinnitus by tinnitus patients. *J. Speech Hear. Res.* **55**, 439–453
- 4 De Ridder D., De Ridder L., Nowe V. *et al.* (2005) Pulsatile tinnitus and the intrameatal vascular loop: why do we not hear our carotids? *Neurosurgery* **57**, 1213–1217
- 5 Tyler R.S. & Baker L.J. (1983) Difficulties experienced by tinnitus sufferers. *J. Speech Hear. Disord.* **48**, 150–154
- 6 Sullivan M.D., Katon W., Dobie R. *et al.* (1988) Disabling tinnitus. Association with affective disorders. *Gen. Hosp. Psychiatry* **10**, 285–291
- 7 Jacobson G. & McCaslin D. (2001) A search for evidence of a direct relationship between tinnitus and suicide. *J. Am. Acad. Audiol.* **12**, 493–496
- 8 Mills R.P. and Cherry J.R. (1984) Subjective tinnitus in children with otological disorders. *Int. J. Pediatr. Otorhinolaryngol.* **7**, 21–27
- 9 Baguley D.M., Humphriss R.L., Axon P.R. *et al.* (2006) The clinical characteristics of tinnitus in patients with vestibular schwannoma. *Skull Base* **16**, 49–58
- 10 Surr R.K., Kolb J.A., Cord M.T. *et al.* (1999) Tinnitus Handicap Inventory as a hearing aid outcome measure. *J. Am. Acad. Audiol.* **10**, 489–495
- 11 Hazell J.W.P., Wood S.M., Cooper H.R. *et al.* (1985) A clinical study of tinnitus maskers. *Br. J. Audiol.* **19**, 65–146
- 12 Baldo P, Doree C, Lazzarini R *et al.* Antidepressants for patients with tinnitus. *Cochrane Database Syst. Rev.* 2006, Issue 4. Art. No.: CD003853. DOI: 10.1002/14651858 pub2
- 13 Simpson J.J. & Davies W.E. (1999) Recent advances in the pharmacological treatment of tinnitus. *Trends Pharmacol. Sci.* **20**, 12–18
- 14 Brookes G.B. (1996) Vascular decompression surgery for severe tinnitus. *Am. J. Otol.* **17**, 569–576
- 15 Jastreboff P.J. (1990) Phantom auditory perception (tinnitus): mechanisms of generation and perception. *Neurosci. Res.* **8**, 221–254
- 16 Jastreboff P.J., Gray W.C. & Gold S.L. (1996) Neurophysiological approach to tinnitus patients. *Am. J. Otol.* **17**, 236–240
- 17 Martinez Devesa P, Waddell A, Perera R *et al.* Cognitive behavioural therapy for tinnitus. *Cochrane Database Syst. Rev.* 2007, Issue 1. Art. No.: CD005233. DOI: 10.1002/14651858 pub2
- 18 Attias J., Shemsh Z., Somer H. *et al.* (1993) Comparison between self-hypnosis, masking and attentiveness for alleviation of chronic tinnitus. *Audiology* **32**, 205–212