

Chapter 1

Introduction

Tinnitus and hyperacusis continue to intrigue patients, scientists and clinicians alike. That so many people can have some experience of these symptoms and not be distressed, while others are troubled to the point that they are no longer able to perform their normal daily activities remains paradoxical. Furthermore, researchers have reported that when tinnitus is matched in intensity in this troubled group of people, it has been indicated to match to sound of low intensity (though the complexities of such experiments will be discussed below). Despite this apparent low intensity the intrusiveness of the symptom in patients with severe tinnitus is remarkable. Given these paradoxes, it is unsurprising that no single approach to tinnitus and hyperacusis has been shown to be overwhelmingly stronger than any other in terms of understanding and managing these symptoms.

The aim of this book is to present a multidisciplinary approach to tinnitus and hyperacusis, incorporating insights from Audiology, Otology, Psychology, Psychiatry and Auditory Neuroscience. It is hoped that this will inspire a collaborative approach to tinnitus and hyperacusis management that will benefit patients and clinicians alike. There is already good evidence that such collaborative and multidisciplinary initiatives in other fields, such as chronic pain, have increased the efficacy of treatments.

Definitions

The word tinnitus derives from the Latin verb ‘tinnire’ meaning ‘to ring’, and in common English usage is defined as ‘a ringing in the ears’ (*Concise Oxford English Dictionary*, Allen, 1990). The first recorded use of the word occurred in 1693 in *Blanchard’s Physician’s Dictionary*, second edition as follows (Stephens, 2000):

Tinnitus Aurium, a certain buzzing or tingling in the Ears proceeding from obstruction, or something that irritates the Ear, whereby the Air that is shut up is continually moved by the beating of the Arteries, and the Drume of the Ear is lightly verberated, whence arises a Buzzing and a Noife (p. 201).

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At the time that this Dictionary was compiled there were many conditions that were thought to be due to trapped air, and procedures were developed to address that. It is interesting that the Blanchard definition fits well with the experience of pulsatile tinnitus, where an individual becomes aware of the sound of arterial or venous blood flow (see Chapter 5).

Some other languages have a variety of words to describe the phenomenon of tinnitus (Stephens, 2000), notably French, where five words are in regular use, each describing a particular timbre or quality of sound. In Swedish the word for tinnitus used to be *Öronsus*, which in direct translation stands for ear breeze. Few patients would agree that their tinnitus sounds like a breeze and this word does not catch the emotional impact experienced by some. There have been various attempts at a scientific definition. McFadden (1982) considered that:

Tinnitus is the conscious expression of a sound that originates in an involuntary manner in the head of its owner, or may appear to him to do so.

This definition has been widely adopted (e.g. Coles, 1987; Davis and El Rafaie, 2000; Stephens, 2000) and has the benefit of brevity. Møller (2011b) distinguishes between *objective* tinnitus (which can be heard, measured or recorded by an external observer) and *subjective* tinnitus, which can be heard by the person alone. As will be shown below, this distinction was made in the work of Itard (1774–1838). Møller defines subjective tinnitus as follows:

Subjective tinnitus is a broad group of sensations that are caused by abnormal neural activity in the nervous system that is not elicited by sound activation of sensory cells in the cochlea (Møller, 2011b, p. 9).

This definition has some insights, as it implies that tinnitus can be varied, both within and between individuals. One might question whether *anomalous* might be a better word than *abnormal*, and this will be unpacked when we consider the neuroscience of tinnitus.

Definitions of hyperacusis have tended to illustrate the perspective of the author. For instance, Vernon (1987a) proposed an open definition as

... unusual tolerance to ordinary environmental sounds.

For Vernon the emphasis may have been upon the *unusual*, as he could only recall four such cases, having seen over 4000 persons with tinnitus. Modern epidemiology indicates that hyperacusis is a more common experience than that. A more pejorative view is that of Klein et al. (1990):

... consistently exaggerated or inappropriate responses or complaints to sounds that are neither intrinsically threatening or uncomfortably loud to a typical person.

Many persons with hyperacusis may have seen clinicians who would ascribe to this view and not been helped by the implied criticism. A less negative definition was proposed by Baguley and Andersson (2007):

... abnormal lowered tolerance to sound.

Attempts have been made more recently to differentiate between those individuals who have a general hypersensitivity to sound that most other people can tolerate (hyperacusis) and those who find specific sounds uncomfortable, perhaps because of emotional associations with that sound. In an initial differentiation between these two the second experience was entitled phonophobia, a term that is commonly used in neurology (Woodhouse and Drummond, 1993), in particular in association with migraine attacks. However, the inference that this phenomenon was essentially phobic in nature can be unhelpful to some patients. Definitions of hyperacusis are further explored in Chapter 10.

Historical aspects

The experience of the perception of sound generated internally has been mentioned in many historical medical texts. These original sources have been reviewed by Stephens (1987, 2000) and Feldmann (1997), and while these authors have many detailed issues upon which they are at variance, they are in broad agreement on the interest expressed in tinnitus by medical authors from historical times. A series of ancient Babylonian medical texts, inscribed upon clay tablets, were housed in the library of King Assurbanipal (668–626 BC) in Ninevah. These were translated by Thompson (1931) and were found to include 22 references to tinnitus, described variously as the ears ‘singing’, ‘speaking’ or ‘whispering’. Treatments are described, including whispered incantations, the instillation of various substances into the external auditory meatus and the application of charms (such as the tooth of a female ibex): specific treatments were advised for each experience of tinnitus as described above (Feldmann, 1997). The involvement of ghosts and spirits in the generation of tinnitus was described, and in particular a quiet incantation method of treatment was largely concerned with driving away such affliction, this being described as the basis of much human disease (Stephens, 1987).

Tinnitus has six mentions in the *Corpus Hippocratum*, a second century AD compilation of the works of Hippocrates of Kos (460–377 BC): each mention relates to a description of ear disease rather than of tinnitus as an experience in its own right. Other authors writing in Graeco-Roman times mentioning tinnitus include Celsus (25 BC–50 AD) who described treatments with diet and abstinence from wine and Pliny the Elder (23–79 AD) who advocated the use of wild cumin and almond oil in cases of tinnitus (Stephens, 2000). The use of sedative medication to treat persons suffering with tinnitus, still in common use in the United States of America and Western Europe, was first described by Galen (129–199 AD), who considered the benefits of opium and mandrake.

Dan (2005) considers a report that the Roman Emperor Titus (39–81 AD) experienced tinnitus. This is found in the Babylonian Talmud, and the tinnitus was considered to be punishment for the destruction of the Second Temple in Jerusalem (70 AD), though the report that at post mortem Titus was found to have a large intracranial tumour offers another perspective on this. Titus is said to have enjoyed some short-lived relief from sound therapy:

A gnat entered his nostril and pecked at his brain for seven years. One day Titus was passing by a blacksmith. He heard the noise of the sledgehammer and the gnat became silent. Titus

thus said: 'Here is the remedy'. Everyday he brought a blacksmith to bang in his presence.... For thirty days this worked fine but then the gnat became accustomed and resumed pecking (quoted in Dan, 2005).

There are mentions of tinnitus in texts within the Islamic medical tradition from the period following the decline of medicine in Rome (Stephens, 1987, 2000, and Feldmann, 1997). These include the first mention of the coincident complaint of tinnitus and hyperacusis (described as an 'increased sensibility') by Paul of Aegina (625–690 AD) (Stephens, 2000, after Adams, 1844).

Advances in the understanding and treatment of tinnitus were not to be seen until the seventeenth century, with the publication of the first text entirely dedicated to the ear and hearing. The *Traite de l'Organe de l'Ouïe* by DuVerney (1683) was translated from the original French into Latin, German, Dutch and English and is recognised as a milestone in Otology (Weir, 1990). The insights into tinnitus represented a move away from the concept that tinnitus may arise from trapped air in the ear, this having persisted since Roman times, towards a model of tinnitus arising from diseases of the ear and disorders of the brain. The implication of the influence of the brain over the ear is prophetic of later concepts of the function of the efferent auditory system in humans. The treatments for tinnitus that are advocated by DuVerney are limited to treatment of the underlying disorder.

A further advance in understanding occurred in 1821 with the publication of *Traite des Malades de l'Oreille et de l'Audition* by Itard. This comprehensive text was based upon 20 years of experience in working with the deaf, and contained numerous case studies, including that of Jean-Jacques Rousseau (1712–1778), the eminent philosopher who became afflicted by tinnitus in later life (Feldmann, 1997). Itard made the distinction between tinnitus experiences arising from sound, thus 'objective tinnitus' such as that caused by somatosounds, and that arising without any acoustic basis, 'false tinnitus' (now described as 'subjective' tinnitus). This distinction is still in use today. In addition to such medical insights Itard described the effect of tinnitus upon an individual: 'an extremely irksome discomfort which leads to a profound sadness in affected individuals' (translation by Stephens, 2000, p. 443). The treatment of tinnitus was, as with previous authors, based upon treatment of the underlying otological condition, though when such treatment failed, however, Itard advocated attention to the behavioural manifestation of tinnitus and in particular to sleep disturbance, when the use of external environmental sounds (such as a watermill for low-pitched tinnitus or an open fire burning damp wood for high-pitched tinnitus) to mask the tinnitus was suggested.

In the late nineteenth century the medical specialty of Otology underwent a renewal of interest and effort, and several individuals have been identified as leaders in this field. Joseph Toynbee (1815–1866) and William Wilde (1815–1876) (the father of Oscar Wilde) were pre-eminent in this regard and wrote extensively on ear disease, including consideration of tinnitus arising from such conditions. Toynbee experienced distressing tinnitus himself and died during an experiment in which he attempted to determine 'the effect of inhalation of chloroform upon tinnitus, when pressed into the tympanum' (Feldmann, 1997, p. 18). MacNaughton Jones (1981) has been credited (Stephens, 2000) with producing

the first book in English on tinnitus alone, which contained a classification of tinnitus based upon the site of origin and a review of contemporary treatments.

The ability to use electronic instruments to measure hearing thresholds accurately by audiometry, and the consequent ability to determine hearing status in patients with a complaint of tinnitus, was developed in the early twentieth century, and became widespread in Western Europe and the United States of America from the 1940s (Weir, 1990). At this time Fowler (1941) considered the characteristics of tinnitus and is credited with the first comprehensive attempts to determine the matching and masking characteristics of tinnitus (Stephens, 2000). Among the insights gleaned by Fowler were that subjectively loud tinnitus is often matched to a low-level stimulus, that tinnitus may be masked by a broadband noise and that it is not possible to generate beats between tinnitus and externally generated tones (Fowler, 1941). In subsequent writings Fowler collaborated with his son, also an Otologist, and formulated a protocol for the examination of tinnitus patients considering the qualities of the sound, the distress associated, as well as the otological health of the patient (Fowler and Fowler, 1955).

In the late twentieth century there was little scientific or clinical interest in tinnitus and the field was kept alive by a small number of dedicated individuals. The work of Jack Vernon has already been cited: Vernon was a Professor of Audiology working for most of his career in Oregon, USA, and developed the first practical wearable masking devices for tinnitus. In the United Kingdom, Ross Coles was a prolific tinnitus researcher, clinician and teacher, and his influence and mentorship is still felt to this day. Coles worked as a Consultant Physician and academic at both Southampton and Nottingham Universities, and was the founder of the long-running European Tinnitus Course. Also from a medical background, though working as a surgeon rather than a physician, Jonathan Hazell specialised in tinnitus, and in his collaborations with Pawel Jastreboff (a neuroscientist) developed an influential model of tinnitus and a concomitant treatment protocol (Tinnitus Retraining Therapy). From an Audiology perspective, Richard Tyler, working at the University of Iowa, has written, researched and taught extensively on how tinnitus can be managed and has been extremely influential. In the early 1980s Richard Hallam, a psychologist working in London, proposed that the natural history of tinnitus is characterised by the process of habituation and pointed out the influence of psychological factors on this process. His work has had a major influence on the clinical management of tinnitus, particularly by psychologists.

Thus there has been evidence of input to tinnitus research from otology, audiology, and to some extent neuroscience. What has been missing until recently, however, has been substantial input from pharmacology, from psychiatry and from auditory neuroscience. There are indications that this is now underway and that the field is becoming characterised by collaboration and teamwork rather than a small number of experts.

Given the existence of tinnitus throughout history and the wide prevalence of tinnitus experience (see Chapter 11 for details), one should expect mentions in art and literature. In fact these are sparser than would be expected. A comprehensive survey of such mentions will have to await another day, but some can be considered here as examples. The Czech composer Smetana (1824–1884) suffered progressive, and eventually profound, hearing loss and associated tinnitus. He wrote his tinnitus into his string quartet ‘From my life’ (1876) as a prolonged sustained high violin note towards the end.

Thomas Hardy (1840–1928) has a character named William Worm, in his novel the *A Pair of Blue Eyes* (1873), speak of tinnitus:

I've got such a noise in my head that there's no living night nor day. 'Tis just for all the world like people frying fish.... God A'mighty will find it out sooner or later, I hope, and relieve me (Chapter 4).

More recently, Woody Allen has the male lead, played by himself, in the film *Hannah and Her Sisters* (1986) experience unilateral tinnitus and hearing loss, and is investigated for an acoustic neuroma. The astute listener may pick up upon references to tinnitus in the lyrics of modern music: artists as diverse as Radiohead, Bob Dylan and the Broken Family Band mention the experience of tinnitus.

This short review of the historical understanding of tinnitus has three underpinning elements. The first is that any consideration of tinnitus and formulation of possible treatment should consider the otological status of the patient and thus involve the treatment of ear disease where indicated. The second is that this otological focus does not obviate the clinician of the responsibility to consider the distress caused by the tinnitus experience and, where significant behavioral manifestation of this is present, to treat that distress. The third is that the understanding and treatment of tinnitus is a changing and developing science.

Summary

From the above it is evident that concern with tinnitus is not new, and in fact is demonstrated throughout written human history. Many scientists, clinicians and artists have considered tinnitus and the involvement of systems of reaction, arousal and emotion. The indications are that a holistic view of tinnitus must consider the involvement of such systems.