



The Independent Medical Expert Group (IMEG) 5th Report

Report and recommendations on medical and scientific
aspects of the Armed Forces Compensation Scheme

February 2020

Topic 7 - Can Tinnitus be Regarded as a Stand-alone Condition under the AFCS?

Key Points

1. Tinnitus remains a scientific and clinical enigma. It is the perception of sound in the absence of actual external sound and is a manifestation of an underlying pathology rather than a single disease. It may relate to ear pathology or to head and neck trauma, neurological, vascular, endocrine and psychiatric disorders or medication side effects and co-morbidities, particularly psychological, psychosomatic and psychiatric disorder.
2. The paper provides a summary of evidence on the present understanding of tinnitus, its characteristics, epidemiology, risk factors and correlates, as well as its clinical management, based on multidisciplinary approaches. There is also a section looking at current thinking on mechanism and pathology.
3. IMEG reviewed UK and international public compensation tinnitus approaches and the restraints imposed by the many gaps in understanding and concluded that tinnitus is heterogeneous and may or not be associated with noise exposure or hearing loss. The underlying pathogenesis and mechanism are unknown and there is no standard test for its existence, agreed scale or method of severity assessment.
4. We recommend no change to present UK no fault compensation for tinnitus and conclude that awards should not be made for tinnitus alone. We consider the AFCS approach generous and will continue to monitor the literature.

Introduction and Background

1. Tinnitus remains a scientific and clinical enigma (1). Derived from the Latin, tinnier to ring, and defined as the perception of sound in the absence of actual external sound, tinnitus is a manifestation of an underlying pathology rather than a single disease. Although most commonly associated with ear pathologies, tinnitus can also occur in relation to head or neck trauma, neurological, vascular, endocrine, psychiatric disorders or medication side-effects and comorbidities are common with tinnitus, particularly, psychological, psychosomatic and psychiatric disorders. (2). Traditionally, tinnitus has been considered an ontological disorder, but advances in neuroimaging methods and development of animal models have increasingly led to an understanding of the role of central auditory neuronal pathways and connections in tinnitus generation. It is common both in adults and children and may or may not be distressing, with variable impact on activities, lifestyle and quality of life. There is no standard test for the existence of tinnitus nor method of assessment of its severity, although subjective durations of impairment, such as none, occasional, repeated and constant intrusion have been suggested as a grading mechanism (2).
2. In recent months, the question has been raised as to whether tinnitus can be accepted as a discrete compensable disorder under the AFCS. To our knowledge, the present AFCS approach to tinnitus compensation is unique in public schemes. The AFCS makes awards for injury or disorder, on balance of probabilities, predominantly due to service-related incidents or exposures on or after 6 April 2005.

Health and Safety legislation and MOD policy at that date and subsequently, mean that claims for chronic noise induced sensorineural hearing loss are rarely awarded under the AFCS, but where hearing loss, sensorineural or other is accepted under the AFCS, the level of the award includes an element which recognises the presence of severe disruptive tinnitus, paid regardless of whether the claimant suffers troublesome tinnitus or not. A fuller discussion of the treatment of tinnitus under the current UK benefit system and other public compensation schemes is included later in this paper.

Characteristics of Tinnitus

3. Tinnitus is a heterogeneous symptom in terms of causation, quality, intensity, intrusiveness and comorbidities. Most commonly it is subjective (heard only by the person), but can be objective, meaning it can be heard by others, unilateral or bilateral, pulsatile or non-pulsatile. In many cases, there is associated hearing loss. The patient may associate it with one or both ears or may report its origin within the head or even external to the body. Tinnitus may be constant or intermittent with an abrupt or, more commonly, insidious onset. Intermittent tinnitus is an almost universal experience and is generally considered non-pathological. The quality of tinnitus is variable and where there is also hearing loss, there is often no direct relation between its quality or volume /amplitude and the degree of hearing loss (3). The distress of tinnitus is not associated with acoustic characteristics but correlates with psychological symptoms (2). Significant tinnitus is also associated with concentration and sleep difficulties (1).

Epidemiology

4. Because of methodological issues such as the definition of tinnitus and assessment of its severity, prevalence estimates of tinnitus are wide (4)(5). A large and reliable study of troubling tinnitus was the UK National Survey of Hearing, which included over 48,000 adults and found a prevalence of 10.1% with 2.8% describing the tinnitus as “moderately annoying”, 1.6% as “severely annoying” and 0.5% as causing “marked impairment of everyday life” (6). The prevalence of tinnitus increases with age up to 70 years, after which some studies suggest it may reduce. There are few incidence studies, but a recent UK general practice study of 109,783 adults with a first-time diagnosis of tinnitus between 2000 and 2016, reported an overall age-standardized incidence rate of 25.0 new tinnitus cases per 10,000 person- years (7). In another large observational UK study, an incidence rate of 5.4 cases of clinically significant tinnitus per 10,000 person-years was reported (8) while, in the Beaver Dam study of a population aged 48-92 years, a baseline prevalence of 8.2% was recorded. Over time the tinnitus improved in the main with cumulative incidence of new cases, over 5 years, 5.7% (9) and at 10 years, 12.7% (10). A recent report of the incidence of tinnitus diagnoses, based on the International Classification of Diseases, in military electronic health records of 85,438 US active duty service members between 2001 and 2015 recorded the incidence rate of tinnitus (per 1,000) rising consistently from 1.84 in 2001 to 6.33 in 2015 (11).

Risk Factors and Correlates of Tinnitus

5. The main risk factor is hearing loss, notably age-related sensorineural loss, noise induced sensorineural hearing loss, otosclerosis, Meniere’s disease, noise exposure and impacted cerumen, while all inner ear disorders are associated with increased prevalence of tinnitus (1). A 2010 Health and Safety Executive (HSE) review of the published peer-reviewed English language literature on tinnitus and its relation to noise exposure at work and noise induced hearing loss, reviewed 23 studies (12). A wide range of tinnitus prevalence was noted (5.9% to 87.5%). This was not unexpected given the different contexts of the studies, which included surveillance surveys and compensation claimants. Other issues included

different definitions of tinnitus and types and levels of noise exposure. The prevalence of tinnitus was higher in those exposed to noise, compared with non-noise exposed, and varied with the noise level and exposure duration. Most studies were cross-sectional but one longitudinal study with 15 years of follow-up suggested that tinnitus may be an early indicator of noise induced hearing loss. In that study tinnitus fluctuated over the study duration, with 16% reporting complete resolution. Where patients also reported anxiety or depression the tinnitus was more troublesome (13).

6. Neurological disorders associated with tinnitus include traumatic head injury, multiple sclerosis, acoustic neuroma and other cerebellopontine angle tumours. In addition, 10% of tinnitus sufferers have normal pure tone audiometry, which has been demonstrated electrophysiologically to be associated with reduced cochlear output, hypothesised to lead to an altered response of neurons in the central auditory system, producing tinnitus (14). Tinnitus may also be associated with infections such as otitis externa and media, meningitis and neurosyphilis and with mechanical causes which include temporomandibular joint problems and neck injury. Other factors include recreational and occupational noise exposure, the latter regarded as the second most common association (1).
7. Causes of objective tinnitus are very rare and relate to conditions that produce sound within or near the ear. Possible vascular disorders include arteriovenous malformations, vascular tumours, carotid or vertebral artery stenosis, aortic stenosis and mitral regurgitation. There are also rare mechanical causes, such as patulous eustachian tube, palatal myoclonus and myoclonus of middle ear muscles (15), while in about 40% of patients no cause is identified (16). Oral medications which may cause tinnitus include aspirin and non-steroidal anti-inflammatory agents, which can also cause reversible hearing loss, anti-malarials, including quinine and chloroquine, loop diuretics, frusemide and bumetanide, antibiotics, such as tetracyclines, doxycycline and minocycline, and macrolides such as erythromycin and aminoglycosides, where hearing loss may be permanent. There may also be risk from cytotoxic drugs such as cisplatin. The risk of medication related tinnitus can be reduced by minimising the dose and duration of treatment and use of only one drug type, although inter-subject variability in the prevalence and severity of ototoxicity among patients receiving similar treatment suggests genetic susceptibility as a risk factor (17)(18). Factors including obesity, cigarette smoking and alcohol consumption (6) have also been implicated.
8. Tinnitus has frequent co-morbidities including depressive and anxiety disorders (19). Depressive illness is found in about a third of patients (20), whereas the lifetime prevalence of anxiety disorders has been calculated as 45% (21). The presence of a mood disorder with tinnitus is associated with greater disability. There is some evidence of a genetic influence. A 2019 Swedish adoptee longitudinal study, based on nation-wide case control register data collected between 1964 and 2015, separated genetic and environmental factors in 1060 adoptees, 19015 adoptive parents and 17025 biological parents. In both adoptive and biological parents about half those with tinnitus also had hearing loss, although type was not specified. The prevalence of clinically significant tinnitus was 2.2% and the Odds Ratio (OR) 2.2 for adoptees with biological parents with tinnitus as compared with OR 1.0 for those with an affected adoptive parent (22).

Mechanism and Pathology of Tinnitus

9. Although tinnitus is a heterogeneous symptom arising in a range of different circumstances, most research on mechanism and pathogenesis has been on tinnitus with associated hearing loss or noise exposure and carried out in small animals (2). The validity of this model is questioned by some experts (23). Results are conflicting with issues such as time course of symptom onset being out of step with possible mechanisms. For example, tinnitus may have rapid onset after noise exposure, but changes in the cortical auditory system postulated as the basis of the tinnitus is established only after a much longer time course; so as yet the mechanism of tinnitus in any context remains unclear (24).

The auditory pathway is made up of the peripheral system (i.e. outer, middle and inner ear) and the central auditory pathway, involving brainstem and auditory cortex. Normal continuous spontaneous neurological activity in the cochlea may be perceived as tinnitus in a silent anechoic environment, but normal environmental sounds usually mask it and the central auditory system selectively filters it out. Tinnitus may be experienced if the cochlea is damaged, e.g. by noise injury, or the environmental sound masking is reduced by impaired hearing or a quiet environment, or the central auditory system of inhibitory activity also fails. Reasons for these events are unknown. Tinnitus can occur in people with a severed auditory nerve suggesting that tinnitus might arise in the absence of input from the ear and be caused by abnormal neural activity generated in the brain without afferent activity from the ear. One possible explanation is that cochlear hearing loss causes reduced cochlear nerve activity and so the inhibitory cortical processes are also reduced and a state of cortical hyperexcitability and downregulation of the cochlear processes results. It is this abnormal cortical neural activity which leads to tinnitus. However, this hypothesis is not proven. Tinnitus is usually experienced soon after hearing loss, but the suggested downregulation changes in the central auditory structures take hours or days to be established.

10. The sensation of tinnitus and its effects on people in many ways resemble chronic neuropathic pain in phantom limb syndrome (25)(26). Here symptoms are referred to a different part of the body from the site of pain generation. Both chronic neuropathic pain and tinnitus include strong emotional elements and discrete affective disorders may also be present (27). In both conditions, there are no essential physical signs nor an objective test of severity. In chronic tinnitus with ear abnormality, tinnitus can be maintained over time without input from the ear. It is now generally agreed by experts that this is due to neuroplasticity.
11. In most circumstances, e.g. post head injury, the results of neuroplasticity are beneficial. However, maladaptive neuroplasticity is also recognised leading to harm and disease symptoms, e.g. chronic neuropathic pain, muscle spasticity and muscle spasm. Such a mechanism is increasingly being recognised in phantom limb pain. Here, pain and other symptoms are referred to an amputated limb in a situation where the symptoms could not have been elicited from that limb but are generated by functional pathologies in the central nervous system (28). Neuroimaging suggests that brain structural anatomical changes in tinnitus are unremarkable (29), but more recent functional neuroimaging studies suggest that functional connectivity in the brainstem of people with tinnitus may be involved. Further the observed changes involve parts of the brain remote from the auditory structures notably the limbic structures, amygdala and dorsomedial thalamus (30).

Clinical Management

12. About 6 million adults in the UK have experienced prolonged tinnitus with most managed in primary care (31). In addition to its 2017 Clinical Knowledge Summary (15), the National Institute for Health and Care Excellence and a large European consortium (2) are presently developing guidelines on assessment, investigation and management of people presenting with tinnitus, including when to refer for specialist management. Since tinnitus is a heterogeneous symptom, linked to a range of underlying or associated pathologies, no single approach to clinical management is effective for the different types, nor without potentially serious side effects. This means that for most cases of tinnitus, lacking an identified underlying condition or pathological mechanism, treatment is based on education, reassurance, conservative supportive measures and, where hearing loss is significant, hearing aids. As no standard test for the existence of tinnitus or objective measure of its disabling effects is available, the diagnosis and physical examination are guided by a detailed clinical history of tinnitus characteristics and audiological, physical and psychological medical history. In most cases it is important not to over-investigate, but all patients with tinnitus should have an audiological assessment. Further referral for MRI imaging or specialist audio-vestibular physician or otolaryngologist

opinion should be guided by the history, clinical examination, otoscopy and audiological findings. Urgent or early secondary referral indications include unilateral or pulsatile tinnitus, tinnitus associated with head injury, and with vascular or neurological signs, facial weakness or severe vertigo. Other reasons for specialist referral, include duration of six months or more, abnormal otoscopy, significant co-morbidities, unilateral non pulsatile tinnitus and bilateral sensorineural hearing loss greater than expected for age.

- 13.** Public and occupational health and primary care have important roles in primary and secondary prevention through key messaging on recreational and occupational noise prevention and limitation. Given its likely role in early onset of age-related hearing loss the importance of healthy lifestyle, including diet, lowering cholesterol and glycaemic load should also be stressed (32). Conservative measures empowering patients to self-care, with reliable information and learning resources, and signposting to appropriate sources of support are initial best practice treatment for persistent bothersome bilateral tinnitus, without marked hearing loss. Some patients without marked audiometric hearing threshold deficit report benefit from hearing aids, acting as maskers by introducing more ambient noise. Use of hearing aids have not been the subject of robust randomised controlled trials and is not endorsed by the current European guideline for tinnitus management in the absence of audiometric hearing loss (2). In some cases, specialized tinnitus maskers are indicated. White noise or environmental devices emitting other sources of background noise, especially at bedtime, can help.
- 14.** No medications are licensed in the UK for treatment of spontaneous tinnitus and, although many have been tried, results in the individual patient have been variable and all potentially carry some risk. Where clinical trials have been conducted, results have similarly been inconsistent. Pre-existing or co-existing anxiety and depressive disorders are common comorbidities with moderate and severe tinnitus and should be treated appropriately. The 2016 Pattyn systematic review (21) suggested that treatment of anxiety disorders may be associated with improvement in the tinnitus symptoms and effects. In persistent tinnitus cases, there is no robust evidence that drugs, neurostimulation, tinnitus masking, tinnitus training therapy, sound therapy, music therapy or dietary and alternative therapies are effective in tinnitus management. However, there is some evidence to suggest tinnitus retraining therapy, may help reduce both symptoms and associated disability and encourage habituation to the tinnitus, particularly in severely affected cases (33), while a randomised controlled trial (RCT) found that acceptance and commitment therapy was beneficial in normal hearing tinnitus sufferers (34). However, cognitive behaviour therapy (CBT) has the strongest evidence base for efficacy in the management of tinnitus (35).
- 15.** Reflecting overall contemporary evidence, best practice management of tinnitus can be summarised as providing tinnitus specific counselling and advice, validated tinnitus-specific, cognitive behavioural therapy and auditory therapeutic measures for the treatment of concomitant hearing loss and comorbidities. Depression and anxiety should be appropriately treated, with pharmacological support if necessary. Psychiatric treatment should also be given on a case-by-case basis as required. With profound hearing loss, cochlear implantation may be appropriate (36).

Public Compensation and Tinnitus

- 16.** Where tinnitus is associated with a primary disorder or injury, e.g. traumatic brain injury, which is accepted for AFCS compensation, the assessment and award will take account of the tinnitus as part of the primary disorder. In the more common situation, where tinnitus is related to noise exposure or hearing loss different arrangements apply in different schemes. There is presently no standard test for the existence of tinnitus or measure of its severity and disabling effects. Attempts at matching and masking techniques and sound synthesizers to assess pitch band with loudness and mask ability

have produced only inconsistent results. Validated standardized grading measure scales for tinnitus severity (37), (38), for clinical management, compensation or disability benefits, have been proposed but none has been generally accepted or adopted. This means that the various schemes lack common approaches to definitions and approaches which reflect expert adviser opinion not generally accepted scientific understanding. Issues affected include scheme definitions of the various degrees of tinnitus severity and its assessment.

17. In international military and occupational injury compensation schemes, tinnitus claims arise most commonly in relation to noise exposure, acoustic trauma or chronic industrial noise hearing damage. Severe tinnitus is often accepted as present where onset has been within a year of noise exposure, has lasted for more than two years, is audible at least 50% of the time, interferes with sleep and concentration and the claimant have sought specialist medical help prior to making the claim. Compensation and benefit systems generally address a wide spectrum of disorders and award outcomes aim to be fair, consistent, equitable and in line with the legislation across the injuries and disorders. Inevitably, there is a degree of arbitrariness in both diagnosis of tinnitus and assessment of severity. In the UK compensation and disability benefits systems, including the War Pensions Scheme and the related Industrial Injuries Disablement Benefit Scheme, where there is a compensable type and level of hearing loss, an addition for tinnitus may be made to the assessment and hence award.
18. There is no international consensus on the size of the addition for tinnitus severity. Some schemes, for example Workers' Compensation schemes in some US states and Canada simply decline to compensate tinnitus. In other countries, e.g. Australia, a flat rate of 5% is added to compensation payable for a noise induced hearing deficit. In yet other schemes, the addition is variable, usually a low addition, e.g. Germany where 2.5-10% is permissible. In the US military scheme, the Department of Veterans Affairs guidelines set out criteria to be met for tinnitus recognition in awards as follows:
 - the claim must be unsolicited
 - there must be a compensable level of hearing loss
 - the claimant must have sought and engaged with treatment of medication, counselling or hearing devices
 - there must be evidence of evidence of personality change or sleep disturbance
 - there must be no other explanation of the symptoms e.g. substance misuse, therapeutic drugs etc.
 - any claim based on self-reported history must be substantiated by family member or significant other
19. One of the most recent military compensation schemes (1998) has been set up in Ireland (39). The scheme was advised by an Expert Group following extensive literature review and discussion with national and international audiological scientists and otolaryngologists with an interest in hearing loss and tinnitus. The subsequent report grades tinnitus as slight, mild, moderate and severe and sets out the published peer-reviewed evidence underlying their recommendations but no definitive criteria for each severity category. Because of the many evidence gaps, inevitably there is much reliance on group members' expert opinion. Compensation is paid for tinnitus only where evidence confirms that it has existed for two years and occurs for 50% of the time. It should have had close time onset to the hearing loss and the complaint should be medically documented ahead of any claim. Assessment additions suggested by the Expert Group are: - mild tinnitus Nil %, moderate 2% and severe 6%.

Conclusion:

20. Tinnitus is a heterogeneous symptom and may or may not be associated with noise injury or hearing loss. When claimed in a civilian or military occupational context there is usually contention of a connection to noise exposure or noise related hearing loss. While this circumstance is most researched, the underlying pathogenesis and mechanism of tinnitus remains unknown. The advent of new brain functional imaging techniques may bring progress. There is no standard test of its existence nor objective method of tinnitus assessment. Most countries' public schemes either do not compensate tinnitus or do so only in a very limited way.

Recommendations:

- In the UK War Pensions Scheme (WPS) we recommend maintenance of the present approach. Where tinnitus accompanies a compensable level of accepted hearing loss, a small addition for tinnitus may be made. This will be less than 20% added to the hearing loss assessment.
- For the AFCS, we recommend retention of the present approach. Lump sum tariff awards for hearing loss will take account of severe tinnitus, regardless of whether the claimant suffers this.
- Based on present limited understanding, as discussed above, we recommend no change in the present AFCS approach to tinnitus compensation. The evidence does not support AFCS awards for tinnitus arising in the absence of a compensable level of service-related hearing loss. We will continue to monitor the literature.

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