



British Tinnitus Association - Registered Charity No: 1011145

Understanding and Managing Tinnitus

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Introduction

Tinnitus is a perception of a sound when no obvious source of sound is apparent. Approximately 5% of the adult population in the UK experience persistent or troublesome tinnitus.

Over the years there have been a number of claimed cures for tinnitus suffering but no 'quick fixes' have proved clinically efficient. Research has made it clear that there is heterogeneity within the tinnitus population, the implication being that there may be a variety of aetiological mechanisms causing the tinnitus. Despite this, the doctor may not be in a situation where he can provide an aetiological link between the perception of tinnitus and one or more defined underlying pathologies. Furthermore, the perception of tinnitus may be linked to emotional changes, which, again, may or may not be related to organic pathology.

This information sheet presents what we have found to be a useful model for information. The aim of this is to learn to live without tinnitus.

'How we hear'

It is important to realise that we do not hear with the ears we hear but with the brain. The ears should be looked upon as a peripheral sensor, transforming mechanical energy (sound pressure variation) into an electrochemical signal. It is the production and recognition of the pattern of this signal that represents hearing and sound perception, and it has to be learnt.

The hearing organs are fully developed in the first weeks of pregnancy and start working at this stage, but the connections throughout the central nervous system are not developed. This development only happens as a consequence of stimulation. The electrochemical signal from the peripheral hearing organ passes through the hearing (cochlear) nerve and then becomes registered in the auditory cortex (grey matter) but also spreads throughout the brain. The nerve cells (neurons) start making connections with each other, like reaching out and shaking hands, forming pathways involving the brain's learning and emotional centre (the limbic system) and the brain's alarm centre (the reticular centre).

While the baby is still in its mother's womb the brain starts registering sounds, in particular repetitive sounds, and one of the first patterns to be recognised is the mother's heart beat. After birth the most consistent repetitive sound is the pattern of the maternal language. At this stage the baby does not understand the words but recognises the tonality and the characteristics of the mother's voice and language. If spoken to in another language, the child would not react.

As the child continues to mature, the hearing development goes into what we could call the reflex stage. This is used to test children's hearing between the age of six to 18 months by 'Distraction' testing. The principle is to get the child's attention by some gentle play or movement in a quiet environment and then stop the play. As the child raises its eyes to find out why play has stopped, a sound is presented from behind/side of the child who, by reflex, turns to explore this sound perception if it is audible.

The continued stimulation and development of the brain builds up an auditory memory leading to what we could call the third stage. With the increased understanding, comes the ability to suppress or ignore a sound, producing a voluntary reaction. In other words, the child does not **have** to come when called but will if he/she decides to do so. This is the start of what is popularly called 'the terrible twos', when small children start testing out their will and desire against the surroundings.

From then on and throughout life, this pattern of registration, selective perception and prioritising of sound continues and further develops, becoming, more and more, an automated process, filtering out unwanted sounds from our conscious mind (cortex). In other words the brain has learned to identify a sound, classify it and habituate to it, to the extent that there may not be any conscious awareness of the sound (sub-cortical fluctuation). The simple reason for this, and the management of all sensory information, is that we have only one thought at a time. If we were consciously aware of all the sensory input to the brain at any given time, we would be unable to think about anything else. Things we can do simultaneously are, therefore, performed through automated processes we have learnt to the extent that we no longer need an active thought process linked to it. However, if a signal from any sensory system changes or triggers awareness, it involves the cortex again and we become conscious of it, eg an itch, a smell or a sound - like tinnitus.

The importance of sound

So far, we have only spoken about the brain's reaction to sound, but we also have to take silence into consideration. In nature, silence is an alarm signal like the proverbial 'calm before the storm'. When the brain becomes aware of a sudden or gradual silence that is not expected, it increases the brain's arousal. This increases the central auditory gain (volume control) which makes any sound perceived at this

stage, sound louder. In 1953 Heller & Bergman showed this nicely with their experiment using medical students. All had normal hearing and no perception of tinnitus. The students were instructed to perform a hearing test in a sound-proof room and then to describe the character of the sounds presented to them. No sound was, however, presented but, in spite of this, 94% of the students pressed the button within five minutes and described different sound perception recognised as tinnitus. Because they were listening in silence they had become aware of the random signal of silence or the random activity within the auditory system. It is like switching on the stereo, but without playing any music - you can hear a humming from the loud speakers, indicating that the system is switched on.

The central auditory gain also helps us to listen to one speaker and ignore others when we are in social gatherings. It is the focusing mechanism of the central auditory gain that helps us to have selective hearing. Professionally, we learn to use our hearing in special ways. A car mechanic can identify engine sound that the layman would not hear. Musicians and naval sonar operators are other examples of professionals relying on their special hearing skills.

When we first become aware of tinnitus, it is a change in the 'status quo' and the grey matter of the brain becomes involved, ie our thought process. As previously mentioned, many people think that the presence of tinnitus is

related to deterioration in hearing or even more sinister causes, ie brain tumours or other diseases of the brain. These thoughts increase the arousal further and thus give an increased central auditory gain and, in some cases, also trigger off a survival reflex. It is important to note that most tinnitus patients are met with little understanding when they first come into contact with the medical profession. Many may further increase their suffering or emotional reactions due to the misinformation first given, such as there is nothing that can be done, and they have to learn to live with it. One can imagine what effect this has on a patient who is in distress and unable to cope.

In this situation the survival reflex kicks in and the brain automatically becomes the surveyor of the tinnitus signal, thereby using the pathway of identification over and over again. There is also an increase in the sensitivity within the auditory pathway, which can lead to less tolerance of other sounds. If this develops further, it can result in over-sensitivity to sound or hyperacusis. As a consequence some of these patients will start avoiding noisy environments and, by doing so, actually make things worse for themselves as they will seek silence which further increases their sensitivity/reaction to sound. In extreme cases, the sufferer develops phobia to sound.

The good news

The good news is that the whole process has been learnt and can, therefore, be reversed through re-

training. The first step in this treatment is to de-dramatise the presence of tinnitus. If the patient is taken seriously by the medical profession and provided with a thorough medical examination to rule out or confirm any medical condition that would need treatment, the doctor can, in most cases, give the patient reassuring information and thereby take away the reason for the survival reflex. Tinnitus is a non-specific symptom and is a very poor indicator of any specific disease and should be looked upon as a nonsensical sound. The identification of the sound has, in most cases, happened when the brain was in a state of heightened arousal. It does not necessarily reflect the level of hearing and this can be explained by the fact that we cannot predict which ear has tinnitus by examining the audiogram.

If the reason for the survival reflex is taken away, the brain will start a process of habituation, like it does to any sound or sensory stimulation after the initial identification has taken place (eg the sound of a cooling fan to the PC, raindrops on the window or the outside traffic noise). Most patients are trying desperately to do things or to find cures for the tinnitus suffering. This obviously leads to what we call tinnitus related activity, ie it underlines the presence of the tinnitus and the use of the pathways of identification. When the survival reflex is taken away, the pathways are less used and the sensitivity in the auditory pathways reduced, as the central auditory gain is turned down and through a learned process, although the tinnitus is still audible, less attention is paid to the tinnitus signal.

We can speed up this process by avoiding quietness and by using other sounds to reduce the contrast between silence and tinnitus. Whether we use hearing aids, white noise generators or environmental sound is not important. The most important thing to remember is that these sounds are there to reduce the contrast between silence and the perceived tinnitus, not to be listened to instead of the tinnitus. As less and less attention is paid to the tinnitus and the mechanism explained above is kicking in, tinnitus becomes mixed up with the background noise and the perception of the sound disappears. Most sufferers would, at this stage, realise that they have not thought of the tinnitus for quite some time, in other words, they have not been aware of it. Whether or not the tinnitus signal is completely gone or is still perceived occasionally, is immaterial. The important thing is that it does not affect quality of life and that the patient no longer suffers from its presence.

Conclusion

The crucial information for any tinnitus sufferer is, therefore, to reiterate that it is not the source of the sound that is important, but the interpretation/attitude to the sound. The patient should, therefore, avoid quietness, stop the checking process and let the doctor take care of the medical side of things. In other words, don't do anything for, or because of, your tinnitus, just avoid silence. By understanding how you use your hearing in everyday life, you will realise that the importance of sound changes with emotional changes and

sensations of well-being. By using simple strategies as outlined above, the brain reverts to its ability to filter out unimportant sensory information,

amongst which tinnitus is one, thereby teaching the sufferer to live without the perception of tinnitus.

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