Tinnitus Research – Animal Models of Tinnitus

In order to fully understand what is happening in such a variable condition as tinnitus we need to be able to investigate the full range of responses – from the subjective or behavioural response (what you're hearing) right down to the response of a single cell in the brain. This is where research using animals becomes extremely important. Animals are among the most vital "tools" in biomedical research as they allow us to study not only differences in behaviour but also differences in basic mechanisms underlying both health and disease, and in far greater detail than is possible in humans.

An animal which has specific characteristics that resemble a human disease or disorder is termed an "animal model". Thus, an animal model of tinnitus requires that the animals perceive a tinnitus sound, but how can we know that an animal is actually hearing a phantom sound? This complicated problem was solved in 1988 by researchers who studied salicylate-induced tinnitus[1] in rats: The rats were trained to behave differently in silence and in the presence of a sound. After the administration of salicylate, the rats displayed the "sound" behaviour in quiet, suggesting the presence of tinnitus[2]. This first animal model of tinnitus was a significant milestone in tinnitus research.

This first step suggested that tinnitus can be induced in animals; however, salicylate-induced tinnitus can simply be "cured" by stopping salicylate intake. Consequently, later efforts focussed on whether animals also perceive permanent tinnitus after noise-induced hearing loss or the administration of drugs which cause damage to the hearing structures in the ear. Most of these studies used similar training procedures as described above, and a particularly interesting study[3] showed that despite receiving the same acoustic trauma, not all animals went on to display tinnitus-like behaviour, similar to the fact that not everyone with a hearing loss also develops tinnitus.

A major drawback of testing all the early animal models of tinnitus is that they involve time-consuming training procedures; it takes weeks or even months of training until the animals reliably display different "silence" and "sound" behaviours. Unfortunately, this makes them unsuitable for pharmacological screening of putative drugs against tinnitus. However, more recently a promising new method of testing has been developed[4] whereby the presence or absence of tinnitus in animals is tested by probing a reflex called the acoustic startle reflex – the same reflex that makes you jump when you hear an unexpected loud noise. Since this procedure just exploits a reflex, no training is required, making it much faster. This new screening could be a vital tool for the search of a drug against tinnitus.

Animal models of tinnitus have enabled researchers to study tinnitus-related changes in brain activity. What we know about "neurophysiological correlates" of tinnitus from such studies will be the topic of my next article.

[1] High doses of salicylate are known to cause temporary tinnitus in humans.
[2] Jastreboff and colleagues, 1988
[3] Kaltenbach and colleagues, 2004
[4] Turner and colleagues, 2006

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