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Tinnitus is the result of the brain trying, but failing, to repair itself

Date: January 15, 2011

Source: Georgetown University Medical Center

Summary: Tinnitus appears to be produced by an unfortunate confluence of structural and functional changes in the brain, say neuroscientists.

FULL STORY

Tinnitus appears to be produced by an unfortunate confluence of structural and functional changes in the brain, say neuroscientists at Georgetown University Medical Center (GUMC).

The phantom ringing sounds heard by about 40 million people in the U.S. today are caused by brains that try, but fail to protect their human hosts against overwhelming auditory stimuli, the researchers say in the January 13th issue of *Neuron*. They add that the same process may be responsible for chronic pain and other perceptual disorders.

The researchers say that the absence of sound caused by hearing loss in certain frequencies, due to normal aging, loud-noise exposure, or to an accident, forces the brain to produce sounds to replace what is now missing. But when the brain's limbic system, which is involved in processing emotions and other functions, fails to stop these sounds from reaching conscious auditory processing, tinnitus results.

"We believe that a dysregulation of the limbic and auditory networks may be at the heart of chronic tinnitus," says the study's lead investigator, Josef P. Rauschecker, PhD, a neuroscientist. "A complete understanding and ultimate cure of tinnitus may depend on a detailed understanding of the nature and basis of this dysregulation."

Tinnitus isn't curable, although antidepressants appear to help some patients, as does the use of masking noise to diminish focus on the ringing sensations.

Using functional Magnetic Resonance Imaging (fMRI), the Georgetown researchers tested 22 volunteers, half of whom had been diagnosed with chronic tinnitus. They found that moderate hyperactivity was present in the primary and posterior auditory cortices of tinnitus patients, but that the nucleus accumbens exhibited the greatest degree of hyperactivity, specifically to sounds that were matched to frequencies lost in patients.

The nucleus accumbens is part of the corticostriatal circuit, which is involved in evaluation of reward, emotion, and aversiveness, says Rauschecker. "This suggests that the corticostriatal circuit is part of a general 'appraisal network' determining which sensations are important, and ultimately affecting how or whether those sensations are experienced," he says. "In this study, we provide evidence that these limbic structures, specifically the nucleus accumbens and the ventromedial prefrontal cortex, do indeed differ in the brains of individuals with tinnitus."

Functional lapses in these same areas have also been implicated to altered mood states and to chronic pain. "Both of these conditions may also involve the inability to suppress unwanted sensory signals," Rauschecker says.

Based on their findings, the researchers argue that the key to understanding tinnitus lies in understanding how the auditory and limbic systems interact to influence perception -- be it sound, emotions, pain, etc.

Grant support was provided by the National Institute on Deafness and Other Communication Disorders, the Tinnitus Research Consortium, the Tinnitus Research Initiative, and the Skirball Foundation.

Story Source:

Journal Reference:

1. Amber M. Leaver, Laurent Renier, Mark A. Chevillet, Susan Morgan, Hung J. Kim and Josef P. Rauschecker. **Dysregulation of Limbic and Auditory Networks in Tinnitus**. *Neuron*, Volume 69, Issue 1, 13 January 2011, Pages 33-43 DOI: 10.1016/j.neuron.2010.12.002

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