

Noise-Induced Cochlear Neuronal Degeneration and Its Perceptual Consequences

Objectives

The main objectives of this proposal are to use measures of auditory electrophysiology and perception to 1) identify the degree of electrophysiological changes in noise-exposed Veterans and 2) determine the impact of these electrophysiological changes on auditory perception. *Our hypothesis is that noise-induced differences in auditory electrophysiology will be associated with decreased speech recognition at high sound levels, difficulty understanding speech in the presence of background noise, and decreased tolerance to loud sounds.* Assessment of noise-related alterations to auditory electrophysiology and identification of the specific auditory deficits resulting from these changes will help guide future treatment options for Veterans suffering from hearing loss.

Plan

This project will investigate auditory electrophysiology and auditory perception in noise-exposed Veterans and individuals with no noise exposure history. This will allow us to identify electrophysiologic changes in Veterans exposed to noise and look for correlations between their physiology and their auditory perception.

Methods

Amplitude of wave I of the auditory brainstem response will be measured in young (no older than 35 years old) Veterans with normal pure tone thresholds who have a history of loud noise exposure as well as in individuals with no noise exposure history who are matched for age. Perceptual changes will be evaluated by measuring speech discrimination in quiet at both a conversational and a high intensity level, speech discrimination in noise, and loudness discomfort level. In addition, distortion product otoacoustic emission compression threshold will be determined from input/output curves as an indicator of outer hair cell survival to account for outer hair cell loss resulting from noise damage that could also negatively influence speech perception.

Clinical Relevance

Individuals with hearing loss and poor speech discrimination ability often have little success with hearing aids because amplifying sound improves the audibility, but not the clarity, of the speech signal. Loud noise exposure may result not only in damage to outer hair cells, but also lead to auditory neuronal degeneration. Neural loss could result in decreased word recognition and may explain why many Veterans have poorer speech discrimination than would be expected based on their ability to detect tones, particularly in noisy environments. Increasing our understanding of the electrophysiological changes associated with noise exposure will aid in the development of rehabilitation strategies that specifically address the auditory deficits experienced by Veterans.

Relevance to VA's Mission

High noise levels experienced during military service, through use of firearms during combat or basic training or from close proximity to aircraft or other loud machinery puts Veterans at an increased risk of developing hearing loss. Hearing loss is one of the most common service-related disabilities and can lead to communication difficulties that result in problems with employment, social isolation, depression, and overall reduced quality of life.

Keywords: Speech perception, noise-induced hearing loss, auditory nerve