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M.D. Valero, K.E. Hancock, S.F. Maison, M.C. Liberman

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Effects of Cochlear Synaptopathy on Miδdle-Ear Muscle Reflexes in Unanesthetized Mice

Valero, M.D.[1,2], Hancock, K.E. [1,2], Maison, S.F. [1,2,] and Liberman, M.C.[1,2]

[1]Eaton-Peabody Laboratories, Massachusetts Eye and Ear Infirmary, Boston, MA 02114, USA
[2]Department of Otolaryngology, Harvard Medical School, Boston, MA 02115, USA

Corresponding author:
Michelle D. Valero
243 Charles St.
Boston, MA 02114
Phone: (617) 573-5514
Fax: (617) 720-4408
Email: michelle_valero@meei.harvard.edu

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Abstract

Cochlear synaptopathy, i.e. the loss of auditory-nerve connections with cochlear hair cells, is seen in aging, noise damage, and other types of acquired sensorineural hearing loss. Because the subset of auditory-nerve fibers with high thresholds and low spontaneous rates (SRs) is disproportionately affected, audiometric thresholds are relatively insensitive to this primary neural degeneration. Although, suprathreshold amplitudes of wave I of the auditory brainstem response (ABR) are attenuated in synaptopathic mice, there is not yet a robust diagnostic in humans. The middle-ear muscle reflex (MEMR) might be a sensitive metric (Valero et al., 2016), because low-SR fibers may be important drivers of the MEMR (Liberman and Kiang, 1984; Kobler et al., 1992). Here, to test the hypothesis that narrowband reflex elicitors can identify synaptopathic cochlear regions, we measured reflex growth functions in unanesthetized mice with varying degrees of noise-induced synaptopathy and in unexposed controls. To separate effects of the MEMR from those of the medial olivocochlear reflex, the other sound-evoked cochlear feedback loop, we used a mutant mouse strain with deletion of the acetylcholine receptor required for olivocochlear function. We demonstrate that the MEMR is normal when activated from non-synaptopathic cochlear regions and greatly weakened in synaptopathic regions and is a more sensitive indicator of moderate synaptopathy than the suprathreshold amplitude of ABR wave I.