The effect of aging on the electrically evoked compound action potential

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Background: Aging typically leads to difficulty understanding speech in background noise. Previous research has explored cognitive and central auditory mechanisms contributing to these age-related changes (e.g. Gordon-Salant & Fitzgibbons 1993; Wingfield & Tun 2001; Wong et al 2009). However, it is likely that the peripheral auditory system may also play a role. One challenge is separating the effects of aging on cochlear structures from the effects of aging on the auditory nerve in humans. Cochlear implant (CI) users provide a unique way to address this issue, as intracochlear electrical stimulation bypasses surviving hair cells and activates the auditory nerve directly. The electrically evoked compound action potential (eCAP) is generated by responses from a large population of auditory nerve fibers to electrical stimulation. A steeper eCAP growth function suggests that with increasing stimulus level, more auditory nerve fibers are available and able to respond to the stimulus. Studies in animal models suggest that age-related loss of spiral ganglion cells could lead to shallower eCAP growth functions and/or increased eCAP thresholds (Hellstrom & Schmiedt 1990; Ramekers et al. 2014; Pfingst et al. 2017) and possibly negatively impact speech recognition.

Goals: To examine the effect of aging on eCAP growth functions and their relationship with speech recognition in noise in CI users.

Methods: Ten younger and ten older postlingually deafened, adult CI recipients participated in this study. eCAP amplitude-intensity functions were recorded from a mid-array electrode and fit using linear functions. Speech recognition in noise was assessed using the QuickSIN test.

Results and conclusion: Older CI users had significantly shallower eCAP growth functions and higher eCAP thresholds than younger CI users. eCAP growth functions were not correlated with speech recognition in noise. Results of this study suggest that aging may negatively impact the auditory nerve, resulting in higher eCAP thresholds and shallower eCAP growth functions. These findings expand our understanding of mechanisms underlying age-related changes in the peripheral auditory system.

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