Age-related changes in the Auditory Steady-State Response Measured across the Lifespan of CBA/CaJ Mice

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Presbycusis, or age-related hearing loss, is the most prevalent type of sensorineural hearing loss. The age-related decline in hearing that gradually progresses across the lifespan of humans also occurs in the CBA/CaJ mouse, making it a very useful animal model. Previous studies have used electrophysiological measures such as the Auditory Brainstem Response (ABR) to assess age effects on peripheral and central auditory function in various strains of mice. However, few studies have been conducted using Auditory Steady-State Response (ASSR) as a tool for assessing temporal processing in aging animal models, and no previous studies have assessed cortical temporal processing in aging mice. The ASSR is elicited by the phase locking of neurons to amplitude modulated (AM) stimuli in a way that follows the temporal modulation of the signal, with higher AM rates generating responses from the midbrain and lower AM rates (<50 Hz) generating responses from the cortex. The purpose of this study was to evaluate the use of ASSR as an effective strategy for detecting age-related changes in auditory function, as well as to further develop our understanding of neurophysiological aspects of presbycusis. We evaluated age-related changes of the auditory pathways by analyzing ASSR data collected from 115 CBA/CaJ mice (58 male, 57 female) grouped by age into young (111-272 days), middle-aged (273-517 days), and old (518-906 days) groups. Responses of the auditory cortex and brainstem were measured using peak magnitude (in microvolts) of the ASSR to acoustic stimuli (400 millisecond (ms) duration, 40 and 80 Hz AM, 65 and 75 dB intensity). Results showed no significant change in peak magnitude across the lifespan, indicating that as mice age, neural synchronization to modulated sounds remains stable with age in the midbrain and cortex. Results also showed more variability in peak magnitude among young mice responding to the 40 Hz modulated stimuli, suggesting that neural coding within the auditory cortex stabilizes after about 200 days into the life cycle. In addition, younger mice exhibit the strongest positive correlation between the modulation frequencies, suggesting that the integrity of neural locking occurring in the midbrain is associated with the integrity of neural locking occurring in the auditory cortex, especially in younger mice. This study provides new insight into presbycusis and the use of ASSR as a method for early identification of age-related neurophysiological changes occurring in the human auditory system.

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Poster Only

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