THE RESPONSE OF AUDITORY NEURONS TO MULTICHANNEL ELECTRICAL STIMULATION IN THE DEAF AND CHRONICALLY STIMULATED COCHLEA

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Multichannel cochlear implants electrically activate auditory neurons along the tonotopic gradient of the cochlea. Discrete populations of auditory neurons are preferentially activated by different intracochlear electrodes to provide frequency information. However, little is known about the precision with which spatial and temporal information is provided by multichannel electrical stimulation or how extended periods of deafness and chronic intracochlear electrical stimulation (ICES) influence this information.

Neonatal cats (n=9) were ototoxically deafened and at two months of age received a multichannel cochlear implant containing seven active intracochlear electrodes. Environmentally derived ICES was delivered chronically via a clinical stimulator (Nucleus CI24M, Cochlear™) and processor (Esprit 3G, Cochlear™) for a period of six months. Control cats (n=4) with normal hearing thresholds were acutely deafened at the time of the electrophysiological experiment. Single unit electrophysiological experiments were carried out to measure the spatial selectivity of auditory neurons in response to electrical stimulation delivered on each intracochlear electrode in monopolar or bipolar configurations. The temporal characteristics of auditory neurons were examined by measuring responses to electrical stimulation of increasing pulse rate.

Electrical stimulation of individual intracochlear electrodes produced selective activation of auditory neurons using both monopolar and bipolar configurations. Chronic ICES did not alter the extent of spatial selectivity across the auditory neurons sampled compared to control cochleae. Auditory neurons within chronic ICES cochleae were able to respond to stimulus pulse trains with 1:1 firing at pulse rates that were significantly greater than auditory neurons in control cochleae ($p<0.001$). These results indicate that auditory neurons are sensitive to both spatial and temporal cues evoked by electrical stimulation in long-term deafened cochleae that have received chronic ICES.

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