PHYSIOLOGICAL AND HISTOPATHOLOGICAL RESPONSE OF THE COCHLEA TO CHRONIC ELECTRICAL STIMULATION OF THE AUDITORY NERVE AT HIGH STIMULUS RATES

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Previous research has shown that chronic electrical stimulation of the auditory nerve using charge balanced biphasic current pulses at rates of up to 500 pulses per second (pps) does not adversely affect the adjacent spiral ganglion population. More recently, a number of clinical trials have suggested that speech processing strategies based on high pulse rates (e.g. 1000 pps), can further improve speech perception. In the present study we evaluated the physiological and histopathological response of the cochlea following long-term stimulation using rates of 1000 pps.

Thirteen normal hearing cats were bilaterally implanted with scala tympani electrodes and unilaterally stimulated using 25-50 μs per phase charge balanced biphasic current pulses presented at 1000 pps. Additional charge balance was achieved by shorting the electrodes between current pulses. Each animal was stimulated for periods ranging from 700 - 2100 hours at current levels within its dynamic range. Auditory brainstem responses to both acoustic (ABR) and electrical (EABR) stimuli were periodically recorded throughout the chronic stimulation program. At completion of the program the cochleas were prepared for histological examination.

While all animals exhibited an increase in acoustic thresholds following surgery, click evoked ABR's returned to near normal levels in half the animals. Frequency specific stimuli indicated that the most extensive hearing loss occurred adjacent to the array (>12 kHz) while lower frequency thresholds appeared at or near normal. Our EABR data showed that the majority of animals exhibited slight increases in threshold, although response amplitudes remained very stable for the duration of the stimulus program. The physiological data reported here will be correlated with cochlear histopathology.

These initial findings suggest that chronic intracochlear electrical stimulation at high pulse rates, using a carefully designed charge balanced stimulator, does not appear to adversely affect the implanted cochlea.

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