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CHRONIC ELECTRICAL STIMULATION OF THE AUDITORY NERVE USING NON-CHARGE BALANCED STIMULI.

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Cochlear implants use charge balanced biphasic current pulses and electrode shorting between current pulses to minimise potentially damaging direct current (DC). In the present study we evaluated the effectiveness of the electrode shorting technique using a non-charge balanced stimulus regime. Under general anaesthesia (ketamine (20 mg/kg. i.m.) and xylazine (3.8 mg/kg. i.m.)), eight normal hearing cats were bilaterally implanted with two channel platinum scala tympani electrodes. Each animal was stimulated unilaterally for 500 to 2200 h using 50 μs monophasic current pulses. The stimuli were delivered at rates of 500 or 2000 pulses per channel continuously at mid-dynamic range intensities. Electrically-evoked auditory brainstem responses (EABR) were periodically recorded to monitor the status of the auditory nerve and to ensure stimulus intensity remained above threshold. At a stimulus rate of 500 pulses/s, electrode shorting effectively reduced DC levels to $\leq 0.3\mu A$. Longitudinal EABR's recorded from these animals remained relatively stable over the stimulus duration. These cochleae showed minimal tissue response and there was no statistically significant difference in spiral ganglion cell density when compared with controls ($p=0.21$, Mann-Whitney U-test). Chronic stimulation at 2000 pulses/s resulted in increased DC levels (0.6-2.8μA). These cochleae exhibited a highly significant reduction in spiral ganglion cell density when compared with controls ($p<0.0001$), and their EABR's typically displayed an elevation in threshold as a function of stimulus duration. The present findings indicate that continuous non-charge balanced stimuli at rates of 2000 pulses/s can result in significant loss of spiral ganglion cells, presumably as a result of increased DC levels.

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