

CHRONIC ELECTRICAL STIMULATION OF THE AUDITORY NERVE IN CATS

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One requirement for the success of a cochlear hearing prosthesis is that long-term electrical stimulation must not have adverse effects on the residual spiral ganglion cell population. Electrochemically 'safe' stimulation regimes have been defined for the cortex (Brummer & Turner, 1977). However, few investigators have examined the effects of long-term intracochlear electrical stimulation. Walsh *et al* (1980), stimulating with current densities greater than the 'safe' limits defined by Brummer & Turner (1977), for periods of up to 800 hours at current levels of 4.0-8.0 mA, recorded slight local neural degeneration adjacent to the electrodes.

Shepherd *et al.* (1982), in a preliminary study, stimulated two cats using a 'safe' stimulation regime for 245 hours and 1040 hours at a current level of 0.5 mA. This stimulation regime was similar to that used by the cochlear hearing prosthesis. There was no significant difference in spiral ganglion cell densities when the stimulated cochleas were compared with implanted, nonstimulated control cochleas. The present study has been carried out to examine in more detail the effect of chronic electrical stimulation on the peripheral auditory nerve.

Ten normal hearing adult cats were used in the present study. Using sterile conditions, bipolar intracochlear electrodes were inserted 5 mm into the scala tympani via the round window. Both cochleas of each animal were implanted, one side being stimulated while the other served as a control. Following a ten day recovery period each animal was placed on a continuous electrical stimulation program using a biphasic, constant current stimulator that presented 500 pulses/sec at 0.2 msec per phase. The asymmetry of the biphasic pulses was measured to be 0.1-0.01%. A stimulus current level midway between threshold and a current level that gave an aversive response was used. The stimulus currents were in the range of 0.5-0.9 mA. This stimulation regime was within the 'safe' range defined by Brummer & Turner (1977). Stimulation times varied from 424 to 2029 hours. On completion of the stimulation program the animals were sacrificed and the cochleas were sectioned serially. Spiral ganglion cell regions adjacent to the electrode were examined and cell densities determined. Seven of the 20 cochleas examined showed varying amounts of infection. The degree of infection was graded for subsequent statistical examination.

Comparison of the spiral ganglion cell densities for both stimulated and control cochleas showed no significant difference, however the effect of infection on spiral ganglion cell densities was significant ($P < 0.05$, Student *t*-test).

This study indicates that chronic intracochlear electrical stimulation using a 'safe' stimulation regime does not result in a reduction in spiral ganglion cell densities.

Brummer, S.B. & Turner, M.J. (1977) *I.E.E.E. Transactions on Biomedical Engineering*, 24, 59.

Walsh, S.M., Merzenich, M.M., Schindler, R.A. & Leake-Jones, P.A. (1980) *Audiology*, 19, 164.

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