CHRONIC ELECTRICAL STIMULATION OF THE AUDITORY NERVE AT HIGH RATES: I.
EFFECT ON RESIDUAL HEARING

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In addition to direct excitation of auditory nerve fibres, cochlear implant patients with small amounts of
residual hearing may receive important additional auditory cues via electrophonic activation of hair cells1.
Before incorporating electrophonic hearing into speech processing strategies, the extent of hair cell survival
following cochlear implantation must first be determined. We have recently demonstrated widespread
survival of hair cells apical to electrode arrays implanted for periods of up to three years2, the present report
describes the effects of chronic electrical stimulation on hair cell survival. Thirteen normal hearing adult cats
were bilaterally implanted with scala tympani electrode arrays and stimulated for periods of 350 - 2100 h at
stimulus rates of up to 2000 pulses per second using charge balanced biphasic current pulses. Click-evoked
auditory brainstem responses and frequency specific compound action potentials (CAP's) were recorded
periodically during the course of the stimulation program. Animals were anaesthetised with ketamine
hydrochloride (20 mg/kg i.m.) and xylazine (3.8 mg/kg i.m.) during both surgery and the auditory
evaluations. All cochleae exhibited an increase in click threshold immediately following surgery, however,
thresholds returned to within 15 dB of pre-surgical levels in 14 of the 26 cochleae examined. Moderate
recovery (15 - 50 dB loss) was observed in six cochleae, while a further six cochleae showed a permanent
elevation in threshold (> 50 dB). Significantly, there was no correlation between elevation in threshold and
electrical stimulation. Frequency specific CAP's indicated that the majority of animals exhibited a moderate
to severe hearing loss in the 12-24 kHz region, i.e. adjacent to the electrode array. At lower frequencies (2, 4
& 8 kHz), thresholds appeared at or near normal despite long-term implantation and electrical stimulation.
These physiological data were consistent with the degree of surviving inner and outer hair cells determined
histologically. Moreover, the extent of hair cell and organ of Corti survival was not related to the degree of
electrical stimulation (p=0.62; Kruskal Wallis ANOVA). The present findings indicate that some degree of
auditory function can be preserved following chronic implantation and high rate electrical stimulation of a
scala tympani electrode array.


SENSORY AND AUTONOMIC NERVES WITHIN THE SHEEP TEMPOROMANDIBULAR JOINT.

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Degenerative joint disease (osteoarthritis) is a common disease of the temporomandibular joint (TMJ)
leading to degeneration, fragmentation and loss of articular surfaces, exposure of
underlying bone and consequent dislocation and perforation of the disc. Although not proven,
these degenerative changes may have marked influences on the nerve endings in these and
adjacent tissues. The microscopic appearance plus the distribution of neural structures within
the normal temporomandibular joint (TMJ) were examined as part of a wider project studying the
effect of arthritis on the innervation of the TMJ of the sheep. Fluorescence histochemistry
(glyoxylic acid), immunoperoxidase, immunofluorescence and gold chloride techniques were
used. Joints from ten mature Merino sheep were studied. CGRP-Immunoreactive nerve fibres
were found in the capsule and synovial membrane but not in the disc. Nerve bundles and single
nerve fibres in the capsule, synovial membrane and the peripheral 2-3 mm of the disc were
stained by glyoxylic acid. Ruffini, Paciniform-type and Golgi organ nerve endings plus free
nerve endings were located in the capsule with the highest density of nerve endings occurring at
the site of attachment of the disc to the capsule. The highest density of neural structures (using
gold chloride) was in the lateral and posterior areas of the joint. The highest density of
autonomic fibres (using glyoxylic acid) was in the anterior capsule and the highest density of
sensory fibres (using CGRP) was in the synovial and subsynovial tissues of the anterior and
lateral capsule. These results confirm the existence of autonomic and sensory nerves in the
capsule, synovial membrane and peripheral disc in normal healthy adult sheep.
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Title:
Chronic electrical stimulation of the auditory nerve at high rates: I. Effect on residual hearing
[Abstract]

Date:
1996

Citation:

Persistent Link:
http://hdl.handle.net/11343/27502

File Description:
Chronic electrical stimulation of the auditory nerve at high rates: I. Effect on residual hearing
[Abstract]