COCHLEAR IMPLANT - BIOMEDICINE

FP143

INTRACOCHLEAR FACTORS CONTRIBUTING TO PSYCHOPHYSICAL PERCEPTS FOLLOWING COCHLEAR IMPLANTATION

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Variations of performance of cochlear implant patients may be related to several factors. In this anatomical study we focus on determining how intracochlear factors affect postoperative psychophysical percepts of the 22-channel cochlear implant system. We have used 3-dimensional (3D) computer reconstruction of cochleas of former Nucleus 22-channel implant patients to quantitatively map intracochlear pathology relative to electrode positions, and relate the type and quantity of pathology to the T and C levels and dynamic ranges of individual electrodes. Preliminary results of this study were presented at the International Symposium on Cochlear Implants, Speech and Hearing Research in Melbourne, October, 1994 (1).

Using the system described by Seldon (2), temporal bone sections were reviewed and analysed on a computer monitor via a Data Translation DT2851 frame-grabber card. We made 3D computer reconstructions from five temporal bones of cochlear implant patients and measured the following factors: distance between electrode ring's center and Rosenthal's canal's center (‘dis’), the cross-sectional areas of fibrous tissue (‘ft’) and new bone (‘nb’) as intracochlear histopathological changes, and the density of residual spiral ganglion cells (‘sgc’) at each electrode ring position. The interrelationship between the postoperative psychophysical parameters (T and C levels, DR) and these factors were analyzed. To correlate the psychophysical percepts with the anatomical factors, Pearson’s correlation coefficients were calculated. Multiple regression analysis was also performed to find the combination of factors that contribute to the performance. In this anatomical study we focus on determining how intracochlear factors affect postoperative psychophysical percepts of the 22-channel cochlear implant system. We have used 3-dimensional (3D) computer reconstruction of cochleas of former Nucleus 22-channel implant patients to quantitatively map intracochlear pathology relative to electrode positions, and relate the type and quantity of pathology to the T and C levels and dynamic ranges of individual electrodes. Preliminary results of this study were presented at the International Symposium on Cochlear Implants, Speech and Hearing Research in Melbourne, October, 1994 (1).

Aim: Since the cochlea shows a significant relation with ‘dis’, i.e., a longer distance contributes to a higher T level. For the DR, a higher ‘sgc’ contributed to a higher DR in three cases, and a longer distance contributed to a higher DR in two cases. A lower T level with a wider DR was considered to be related to sensitivity and function of the inner ear and speech recognition ability (3). So a shorter ‘dis’ and a higher residual ‘sgc’ (or, in the other cases, lower intracochlear changes) contribute to good speech recognition ability.

2) Seldon HL: Three-dimensional reconstruction of temporal bone from CT scans on a personal computer. Arch Otolaryngol Head Neck Surgery 1991; 117:1158-1161

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MONDINI MALFORMATION, IS A COCHLEAR IMPLANT INDICATED?

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Are Mondini’s patients with profound sensorineural hearing impairment candidates for a cochlear implant? There is no preoperative test to determine a sufficient number of cochlear neural elements for stimulation. Based on results of examinations of successfully implanted non-Mondini temporal bones, it is believed that the spiral ganglion cells are most probably neuron elements stimulated by cochlear implant. Therefore, in order to determine if Mondini’s bones may have enough spiral ganglion cells for cochlear implant stimulation. We counted population of spiral ganglion cells in the mid-modiolar sections of bones from four patients with Mondini’s malformation and with cochlear implant and in sections from five bones from four patients without Mondini’s but with two-to-ten years history of successful implant use. Five bones with normal anatomy from three patients with normal hearing served as controls. The six Mondini’s ears averaged an average of 390 spiral ganglion cells, with a range of 254 to 7. The five implant ears had 384, with a range from 291 to 504. These numbers are almost the same. Both are about 45% of the population of the control bones, which averaged 846.

Results of this limited sample of Mondini’s bones indicated the possibility that they may have enough spiral ganglion cells to auditory response to cochlear implant stimulation.

THE ROLE OF ENDOTHELIUM IN VASOREGULATION BY COCHLEAR NEUROTTRANSMITTERS IN GUINEA PIGS. THE INVOLVEMENT OF ATP-SENSITIVE POTASSIUM CHANNELS.

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Background: Acetylcholine, calcitonine gene-related (CGRP) and nitric oxide (NO) have been postulated to have a neuromodulatory role in cochlear function. These neurotransmitters release from cochlear nerves, due to electric signals might contribute to an increase in blood flow through the cochlea. The aim of the present study was to study whether the role of ATP-sensitive potassium (KATP) channels in the cochlea as mediators of the vasodilatory and neurotrophic effect of cochlear nerves.

Methods: Cochleas prepared from adult male guinea pigs were placed in an organ chamber (5 ml) filled with temperature-controlled Krebs solution, pH 7.2, a control Krebs solution, and PH 7.2-controlled oxygenated Krebs solution. After equilibration of the organ chamber (20 minutes), the cochlea was stimulated with 100 Hz, 50 µA pulses, 10 s, and the control Krebs solution was washed with fresh Krebs solution. After the washout period, the organ chamber was filled with fresh Krebs solution, and the cochlea was stimulated with 100 Hz, 50 µA pulses, 10 s, and 10 s were repeated with two platinum wire electrodes each side of the preparations connected to an "Elecstim" two channel programmable stimulator. Thoracic aortic ring preparation was used as a control. The following factors were measured: 1) blood flow through the cochlea; 2) phosphorylation of the KATP channel; 3) ATP content of the cochlea; 4) histological changes.
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THE ROLE OF ENDOTHELIUM IN VASOREGULATION BY COCHLEAR NEUROTRANSMITTERS IN GUINEA PIGS. THE INVOLVEMENT OF ATP-SENSITIVE POTASSIUM CHANNELS.

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Background: Acetylcholine, calcitonin gene-related peptide (CGRP) and nitric oxide (NO) have been found to modulate the function of cochlear nerves. These neurotransmitters and gasotransmitters are known to induce vasodilation, therefore, they are believed to influence the function of cochlear nerves. There is evidence that electric signals might induce vasodilation in cochlear vessels. Aim: Since the vasodilation of these mediators is believed to be mediated by ATP-sensitive potassium (KATP) channels, the present work was to study whether KATP channel opening was involved in the vasodilatory response of cochlear vasculature to activation of cochlear transmitter release from cochlear nerves. Methods: Cochlear vessels from adult guinea pig were placed in an organ chamber (5 ml) filled with temp and pH (7.2)-controlled oxygenated Krebs solution. The vessels were then mounted on small plastic hooks. Stimulation (FS) with 50 Hz, 40 V square impulses of over 10 s were applied via two platinum wire electrodes each side of the preparations connected to an Experimex two channel programmable stimulator. Thoracic
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