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 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 Rosenthals canals center ('dis'), the cross-sectional areas of fibrous tissue ('ft') and new bone ('nb') as intracochlear pathology, 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 'dis') and these factors was 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.

The results showed several significant correlations and regressions, allowing us to draw some overall conclusions. For the T level, three cochleas showed a significant relation with 'dis', i.e., a longer distance contributed 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

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 postoperative examinations of successfully implanted non-Mondini temporal bones, it is believed that the spiral ganglion cells are most probably not present in Mondini's patients. We attempted to determine if Mondini's bones may have enough spiral ganglion cells for cochlear implant stimulation. We counted the population of spiral ganglion cells in the mid-modiolar sections of the cochleas of four patients with Mondini's malformation and with a cochlear implant in and 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 had an average of 390 spiral ganglion cells, with a range of 254 to 530. The five implant ears had 384, with a range from 291 to 504. 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 indicate the possibility that they may have enough spiral ganglion cells for auditory response to cochlear implant stimulation.

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, calcitonine gene-related (CGRP) and nitric oxide (NO) have been found to induce vasodilation, therefore, we have postulated that these neurotransmitters release from cochlear nerves, due to electric signals might contribute to an increase in blood flow through the cochlea. Aim: Since the involvement of these mediators is believed to be underlain at least in part by activation of ATP-sensitive potassium (KATP) channels, we worked to study whether KATP channel opening was mediated by an electric effect. Methods: Cochleas prepared from adult male guinea pigs were placed in an organ chamber (5 ml) filled with Krebs solution (37°C) and PH (7.4)-controlled oxygenized Krebs solution, and perfused at a rate of 5 ml/min throughout the experiment. The carotid sinus baroreceptors were removed to exclude the possibility of reflex vasodilatation. Results: Baseline arterial pressure in the organ chamber was 95 ± 3 mm Hg (mean ± SE). Arterial pressure decreased by 10% at stimulation of 1 Hz; however, the decrease was not statistically significant. A stepwise increase of the frequency of stimulation resulted in an increase in the decrease of baseline arterial pressure. This frequency-dependent decrease of arterial pressure was significantly larger than the baseline arterial pressure at stimulation of 5 Hz. Conclusion: We showed that a stepwise increase in the frequency of cochlear nerve stimulation might modulate the arterial pressure. This effect might be mediated by an electric effect, which is at least in part due to activation of KATP channels.
COCHLEAR IMPLANT - BIOMEDICINE

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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 three-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 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 the multiple regression analysis, T and C levels and DR were used as dependent variables, and the anatomical factors as independent variables.

Values for 'dis' were 1.1-2.2 mm and tended to be shorter toward the apex of the cochlea. All cochleas showed several histological changes (ft and nb) along the electrode array, and there was considerable individual variation. Four had notable changes (more than 10 mm³), and two of those had much new bone formation. The histological changes tended to be greater in the lower basal turn, and there was a high correlation between histological changes and 'dis'. The total number of residual spiral ganglion cells was 5591-11001, with one exception (21158).

The results showed several significant correlations and regressions, allowing us to draw some overall conclusions. For the T-level, three cochleas showed 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 higher 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.

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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 (CGRP) and nitric oxide (NO) have been found to modulate cochlear blood flow. Acetylcholine and CGRP are known to induce vasodilation, therefore, we postulate that neurotransmitter release from cochlear nerves, due to electrical signals, might contribute to an increase in blood flow through vasodilation. Aim: Since the vasodilators of these mediators are believed to be underlain by activation of ATP-sensitive potassium (KATP) channels, the work was to study whether KATP channel opening was a possible vascular effect of electrical activation of cochlear nerves. Methods: Cochleas prepared from adult male guinea pigs were placed in an organ chamber (5 ml) filled with temperature- and pH (7.2)-controlled oxygenized Krebs solution. The tissues were then mounted on small plastic hooks. Two platinum wire electrodes were placed over 10 s were applied via two platinum wire electrodes. The preparations were then mounted on a computer monitor. Each side of the preparations was connected to an Eppendorf two-channel programmable stimulator. Thoracic
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