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THE HISTOLOGICAL AND PHYSIOLOGICAL EFFECTS OF THE AUDITORY BRAINSTEM PROSTHESIS OF THE AUDITORY PATHWAY

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The cochlear implant can successfully rehabilitate the majority of profoundly deaf patients. However, some of them cannot benefit from the cochlear implant due to bilateral interruption of the auditory nerve, particularly from neurofibromatosis II. These patients can be stimulated directly with an auditory brainstem prosthesis on the cochlear nucleus. To examine the safety and the efficacy of this prosthesis, the cochlear nuclei of guinea pigs were implanted unilaterally with bipolar surface electrodes, and stimulated acutely using charge-balanced, biphasic current pulses at rates of 250, 500 or 1000 Hz and charge intensities of 1.8, 2.8, 3.5 or 7.1 $\mu C/phase/cm^2$. The electrophysiological effects of the prosthesis on the auditory pathway were examined with the electrically evoked auditory brainstem response (EABR), which was used to monitor neuronal excitability of the auditory brainstem during and following six hours of continuous electrical stimulation. The amplitudes and latencies of the EABR waves were measured and compared before, during and after stimulation. The results showed that no significant change was found in the EABR's waveform, amplitudes and latencies pre- and post-stimulation, indicating no change in the responsive capability of the auditory brainstem. The activation of the central auditory pathway by the prosthesis was demonstrated with the 2-deoxyglucose (2-DG) technique, which was also used to double check the EABR

results. There was broad 2-DG labelling in ipsilateral cochlear nucleus and bilaterally in the inferior colliculi, indicating unusual stimulation of the ipsilateral ascending pathway. Histological analysis was performed on all cochlear nuclei with 3-dimensional reconstruction techniques. The volumes of cochlear nuclei and the neuron sizes in the cochlear nuclei were compared between the stimulated and unstimulated side. No histological difference was observed between the stimulated cochlear nuclei and the control sides. These results suggest that the auditory brainstem prostheses can safely and effectively activate the auditory pathway with the parameters from the cochlear speech processor in guinea pigs. More work on the effects of chronic implantation and stimulation is in progress.

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