Spatial and temporal characteristic of auditory neurons in response to deafness and chronic electrical stimulation.

Wise, A.K.[*†], Fallon, J.B.[*†], O'Leary, S.J.[*†], Sly, D.J.[†] and Shepherd, R.K.[*†]

[*]The Bionic Ear Institute, Melbourne, Australia.
[†]The Department of Otolaryngology, University of Melbourne, Australia.

Introduction: Multichannel cochlear implants electrically activate auditory neurons along the tonotopic gradient of the cochlea. Discrete populations of auditory neurons are preferentially activated by different intracochlear electrodes to provide frequency information. However, very little is known about the precision with which spatial and temporal information is provided or how extended periods of deafness and chronic intracochlear electrical stimulation influence this information.

Methods: Neonatal cats were ototoxically deafened and at two months of age received a multichannel cochlear implant containing seven active intracochlear electrodes. Environmentally derived electrical stimulation was delivered chronically via a clinical stimulator (Nucleus CI24M, Cochlear™) and processor (Esprit 3G, Cochlear™) for a period of six months. Single unit electrophysiological experiments were carried out to measure the spatial selectivity of auditory neurons in response to electrical stimulation (200Hz pulse trains) delivered on each intracochlear electrode in monopolar or bipolar configurations. The temporal characteristics of auditory neurons were examined by measuring refractory properties using a two-pulse protocol and responses to electrical stimulation of increasing frequency (maximum following rate).

Results and Conclusions: Electrical stimulation of individual intracochlear electrodes produced selective activation of auditory neurons using both monopolar and bipolar configurations. Long-term deafness and chronic implantation did not alter the proportion of selective auditory neurons compared to control cases (normal hearing cats acutely deafened). Auditory neurons within deafened cochleae that received chronic electrical stimulation were able to respond to stimulus pulse trains with 1:1 firing at frequency that were significantly greater than auditory neurons in control cochleae. These results indicate that auditory neurons in long-term deafened and chronically stimulated cochleae are capable of providing both spatial and temporal information.

Poster presentation

Corresponding Author

Dr Andrew Wise
Bionic Ear Institute
384-388 Albert Street
East Melbourne 3002
(+613) 9929 8288 ph
(+613) 9663 1958 fax
awise@bionicear.org

Support provided by the Garnett Passe and Rodney Williams Memorial Foundation, NIDCD (HHS-N-263-2007-00053-C) and the Bionic Ear Institute