Evaluation of auditory nerve fibre recruitment by eABR *via* cochlear implant stimulation in the guinea-pig model

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The cochlear implant is a revolutionary device that provides hearing to tens of thousands of severely hearing impaired children and adults worldwide. The quality of sound perception received by implant users is greatly variable, and optimal performance of the device relies on the integrity of the spiral ganglion neurons (SGNs). The health and functionality of SGNs is dependent upon neurotrophic support provided by hair cells and supporting cells of the organ of Corti. As the function of the cochlear implant is to essentially replace the role of hair cells when they are lost it is of great interest to develop therapies that can improve SGN health after hair cell loss and implantation.

In animal models of sensorineural deafness the effectiveness of therapies and integrity of SGNs can be analysed histologically after the termination of experiments. More valuable information can be gained through electrophysiological analysis of SGN performance, which can be achieved by measuring electrically-evoked auditory brainstem responses (eABR). We have developed a protocol for determining eABR threshold for nerve fibre recruitment *via* stimulation of an implanted cochlear implant electrode array.

Under an approval from the University of New South Wales Animal Care and Ethics Committee, we used isoflurane anaesthesia to implant the electrode array in the guinea-pig cochlea and undertake eABR recordings. ABR recording electrodes (subdermal) were placed at the vertex of the skull and lateral temporal region on the implant side; a reference electrode was inserted in the flank. We used alternating monophasic pulses of 100 μs duration delivered *via* the cochlear implant array and averaged over 512 trials. We set a suprathreshold maximum stimulus of 1 mA, with successive 2 dB reductions and found that robust eABR thresholds were achieved using around 250 μA current referenced to 1 mA at 70 dB. The P1 latency of the eABR occurred around 400 μs from the stimulus onset. These baseline threshold data, along with input/output functions, will enable assessment of central auditory drive in future studies aimed at regenerating the peripheral spiral ganglion neurites *via* neurotrophin-based gene therapy approaches. With outgrowth of spiral ganglion neurites back through the osseous spiral lamina to the region of the *habenula perforata*, lowered stimulus thresholds are predicted (after Landry *et al.*, 2011) which should enable increase dynamic range for encoding auditory information for cortical processing.

Landry T, Wise A, Fallon J & Shepherd R (2011) Spiral ganglion neuron survival and function in the deafened cochlea following chronic neurotrophic treatment. *Hearing Research* **282**: 303-313.

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