VENTRAL COCHLEAR NUCLEUS NEURONE RESPONSES TO ELECTRICAL STIMULATION OF THE AUDITORY NERVE IN THE CAT

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Discharge patterns of cat auditory nerve fibres stimulated by constant-current biphasic pulses have been previously described (Javel *et al.*, in press). However details of neural activity elicited central to the auditory nerve by such pulses are not yet determined. The scope of this study was to describe the activity elicited by such pulses, in the auditory neurones thought to receive direct auditory nerve fibre input - those of the ventral cochlear nucleus (VCN) exhibiting a "primary-like" (PRI-like) response. The objective was to compare the electrically- and acoustically-elicited responses of these neurones. The observed differences will be used to direct future efforts in the choice of electrical stimuli which would produce discharge patterns more akin to those elicited acoustically.

Normal hearing cats were anaesthetized with pentobarbitone sodium (40 mg/kg intraperitoneally) for the duration of the experiments. A bipolar stimulating electrode was implanted unilaterally into the scala tympani, and the ipsilateral cochlear nucleus exposed. Stimuli consisted of acoustic tone bursts of short duration and charge-balanced constant-current biphasic pulse trains at 100, 200 and 400 pulses per second, from threshold to saturation intensities. Discharge patterns of single VCN units were recorded extracellularly; each unit's characteristic frequency (CF) was determined, and post-stimulus-time (PST), stimulus-period and interspike-interval (ISI) histograms constructed from spike trains obtained over 200 stimulus repetitions. PRI-like units were identified from their acoustic PST histogram at CF, according to Pfeiffer's (1966) classification.

Neural responses to electrical stimulation were dominated by a 1.0-1.3ms latency, and were always highly synchronized to the current pulses. Discharge rate grew rapidly and monotonically over a narrow dynamic range. Low current levels elicited a predominantly onset PST response, with firing rate decreasing throughout the stimulus pulse train. ISI activity at low current levels was at multiples of the stimulus period. With increasing current level, every pulse became capable of eliciting a spike, culminating at saturation, when all firing was at the stimulus pulse rate. Saturation firing rate occured at progressively higher current levels with increasing pulse rate.

Thus, at the pulse rates tested, the electrical stimulus was highly effective in eliciting neural responses central to the stimulated auditory nerve fibres. Similar discharge patterns have been recorded from electrically-stimulated auditory nerve fibres (Javel *et al.*, in press). The close correspondence between acoustically-elicited discharges from auditory nerve fibres and PRI-like VCN neurones, is also preserved with electrical stimulation.

The deterministic nature of electrically-induced discharge patterns of the PRI-like VCN units, contrasted with the acoustically-driven stochastic responses of such neurones described by Pfeiffer (1966). This difference between the patterns produced by the two modes of stimulation suggests that electrical stimuli which are capable of eliciting less deterministic discharges would approximate more closely the acoustic patterns. Such stimuli may be more effective in providing information useful to speech processing by cochlear implant patients.

Javel, E., Tong, Y.C., Shepherd, R.K. & Clark, G.M. (in press) Annals of Otology, Rhonology and Otolaryngology.

Pfeiffer, R.R. (1966) Experimental Brain Research, 1, 220-235.

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