

THE EXCITABILITY OF UNITS IN THE CENTRAL NUCLEUS OF THE INFERIOR COLLICULUS TO MONAURAL ELECTRICAL STIMULATION

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Single unit responses to electric stimuli can be markedly different to those obtained with comparable acoustic stimuli. For the development of future cochlear implant coding strategies a detailed understanding of the effects of electrical stimulation is required. This study investigated the comparative number of single units exhibiting excitatory responses in the central nucleus of the inferior colliculus to monaural electric versus acoustic stimuli.

Cats (2-4kg) were anaesthetised with ketamine (40mg/kg, i.p) and Rompun (30mg/kg, i.p). The anaesthetic level was maintained by supplementary doses of Nembutal (0.3-0.5ml, i.v). Feline versions of the multichannel bipolar Melbourne/Cochlear scala tympani electrode array were implanted into a neomycin-deafened cochlea. Each unit's centre frequency and binaural interaction class (EE=contralateral and ipsilateral excitatory, EO=contralateral excitatory only, and OE=ipsilateral excitatory only) were established. Stimuli were bursts of charge balanced (100 μ s/phase) biphasic electric pulses (125-4000 pulses per second) or tone bursts at the unit's centre frequency. The monaural stimulus modes were:- 1. with the contralateral cochlea neomycin-deafened, implanted and electrically stimulated whilst the ipsilateral cochlea was left intact and acoustically stimulated. 2. with the ipsilateral cochlea neomycin-deafened, implanted and electrically stimulated whilst the contralateral cochlea was left intact and acoustically stimulated. Microelectrode tracks were marked and following perfusion under deep anaesthesia, some were histologically verified using frozen sections.

These single unit population studies show that when the contralateral cochlea is implanted there is a significantly larger proportion of ipsilaterally excitatory driven units and a significantly smaller proportion of contralaterally excitatory driven units. The relative proportion of EE units remains the same, that of the EO units shows a large and significant decrease, and that of the OE units a large and significant increase compared to normal acoustic stimulation (Semple & Aitkin, 1979). Ipsilateral electrical stimulation results in approximately the same proportion of units showing excitatory responses to ipsilateral or contralateral stimulation as for normal acoustic stimulation. The relative proportions of EE, EO and OE units remain similar to those for normal acoustic stimulation.

For electrical stimulation, as for normal acoustic stimulation, the EE and OE units remain a predominantly a lower (<3.2kHz) centre frequency group and the EO units a higher (>3.2kHz) centre frequency group with the following differences. For contralateral electrical stimulation the EO unit population centre frequency statistics showed a significantly larger population of lower centre frequency units whilst the OE unit population centre frequency statistics are decidedly similar to those of the EE units. For ipsilateral electrical stimulation the EE unit population centre frequency statistics show a significantly smaller population of lower centre frequency units.

This investigation shows that for contralateral (not ipsilateral) neomycin deafening and subsequent electrical stimulation there is a large and significant reduction in the number of units that respond in an excitatory manner. Concurrently, there is a large and significant increase in the number of units that respond in an excitatory manner to ipsilateral stimulation. These results manifest as the emergence of a large and significant OE unit population.

Semple, M.N. & Aitkin, L.M. (1979) *Journal of Neurophysiology*, 42, 1626-1639.

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