INTRACELLULAR RECORDINGS FROM THE AUDITORY CORTEX: AN in vivo ELECTROPHYSIOLOGICAL AND MORPHOLOGICAL STUDY

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This study investigated the basic intracellular physiological properties of morphologically identified neurones in the cat auditory cortex (AI) using in vivo intracellular recording and dye filling. Anaesthesia was maintained at surgical levels in three adult cats (sodium pentobarbital, 40 mg/kg i.p.), and AI neurones were recorded with KAc filled glass micropipettes (40-70 MΩ) containing 4% Neurobiotin. Forty six neurones, isolated between layers I-VI, were identified morphologically, and classified as pyramidal (Py, n=26), multipolar (Mp, n=16), stellate (S, n=2) and bipolar cells (Bp, n=2). Stable impalements were made from 24 neurones, of which 23 were spontaneously active and classified as having fast (<10 ms) or slow (>10 ms) depolarisation to action potential generation, (fast n=13; slow n=10). After-hyperpolarisation potentials were seen in just under half of these spontaneously active neurones. In six morphologically identified neurones (4 Py, 1 Mp and 1 Bp), current was injected through the micropipette (-0.6 to 1.0 nA in 0.1 nA steps) to establish their current-voltage (IV) relationship, input resistance and time constant. Input resistances and time constants ranged from 11-73 MΩ (mode 40 MΩ) and 1.5-9 ms (mode 6.5 ms) respectively. All six IV curves showed linear characteristics over a wide current range (-0.4 to 0.4 nA). Tonic firing in response to current injection was seen in 4 of these neurones (3 Py, 1Bp). The Mp neurone responded with a single spike (phasic), while one Py did not respond. These initial results are part of an ongoing study investigating changes in AI neurone morphology and physiology with deafness.

CHANGES IN EXCITABILITY OF THE AUDITORY NERVE FOLLOWING ELECTRICAL STIMULATION USING LARGE SURFACE AREA ELECTRODES

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High rate intracochlear electrical stimulation at intensities well above clinical limits can induce significant reductions in the excitability of the auditory nerve. Such changes are primarily associated with stimulus induced neuronal activity, although direct current (DC) can also contribute. In the present study we examined the extent of stimulus induced change in auditory nerve excitability using large surface area platinum (Pt) electrodes (high-Q). These electrodes have an effective surface area 10-20 times larger than standard Pt electrodes, resulting in lower DC charge density for a common stimulus. Twenty-three guinea pigs anaesthetized with ketamine (40 mg/kg i.p.) and xylazine (4 mg/kg i.p.), were bilaterally implanted with either high-Q or standard Pt electrodes, and unilaterally stimulated for two hours using a stimulus intensity of 0.34 lC1phase at stimulus rates of 200, 400, or 1000 pulses/s (pps). Electrically evoked auditory brainstem responses (EABRs) were recorded before and periodically following the acute stimulation. No reduction in EABR amplitude was observed at 200 pps for both stimulating electrodes. However, EABRs were reduced significantly at 400 and 1000 pps. At 200 pps there was no significant difference (p>0.05; ANOVA) in the post-stimulus recovery of EABR amplitudes following stimulation with either high-Q or standard Pt electrodes. There was, however, significantly greater EABR recovery following stimulation with the high-Q electrode compared with the standard Pt electrode at 400 pps (p<0.05) and 1000 pps (p<0.05). These data indicate that large surface area high-Q electrodes can significantly reduce stimulus induced changes in auditory nerve excitability, and may therefore have important clinical application.
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