Timecourse of development of hyperactivity in the auditory midbrain after cochlear trauma

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Hyperactivity (increased spontaneous firing rates) is a change in central auditory neuron behaviour that has been suggested to relate to the perception of tinnitus. Hyperactivity has been observed in the auditory brainstem and midbrain from approximately 1 week after acoustic trauma, but the detailed timecourse of its development has not been investigated. We employed single neuron recording to measure spontaneous firing rates in the inferior colliculus (IC) of anesthetized guinea pigs. Animals were exposed to a loud 10kHz tone under general anaesthesia (5mg/kg valium, i.p., 1ml/kg Hypnorm, i.m.). After varying recovery times animals were re-anaesthetized for terminal single neuron recordings (initial dose sodium pentobarbitone 30mg/kg, i.p., supplementary dose every 2 h and initial dose 0.15ml Hypnorm i.m., supplementary dose every h, and paralyzed with 0.1ml pancuronium bromide i.m.). Significant hyperactivity was present at 12hrs post acoustic trauma. In a previous study in the same animal model we found no evidence of hyperactivity within approximately 4hrs post acoustic trauma (Mulders & Robertson, 2009). These data suggest that hyperactivity begins at some time between 4 and 12h post trauma and they are roughly consistent with previous findings in cat auditory cortex (Norena & Eggermont, 2003). At recovery times of 12 and 24h hyperactivity was widespread across most of the frequency representation in the IC, but at longer recovery times, it became progressively more restricted to regions representing the range of frequencies that showed persistent cochlear damage. The results show that hyperactivity in the midbrain begins within hours rather than days post acoustic trauma and it is therefore possible that hyperactivity in auditory cortex may be driven in part, by hyperactivity in inferior colliculus. In addition, the topographic pattern of persistent hyperactivity may correspond to the fact that tinnitus is often reported to have a spectral content corresponding to frequency regions of hearing loss (Norena *et al.*, 2002).

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