Evidence from collision experiments that onset chopper neurons in the guinea pig cochlear nucleus receive excitatory input from centrifugal collaterals

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In mammals, centrifugal pathways from the superior olivary complex to the cochlea, send collateral projections to the first brainstem nucleus, the cochlear nucleus. The action of these collateral pathways needs to be taken into account in any attempt to understand the role of the centrifugal olivocochlear system in auditory processing. To date however there is only incomplete understanding of the neuronal targets of the collaterals and of their synaptic effects (Benson & Brown, 1990; Mulders *et al.*, 2003; Mulders *et al.*, 2002). We have observed in guinea pigs that electrical stimulation at the floor of the IVth ventricle (the site of passage of the centrifugal axons as they ascend from the superior olivary complex), gives rise to short-latency action potentials in well-characterized onset chopper neurons. The nature of these electrically-evoked spikes however, is unclear, since they show an ability to follow quite high rates of electrical stimulation, perhaps consistent not with an excitatory synaptic drive from centrifugal collaterals, but rather, antidromic spikes initiated in the dorsally-ascending axons of the onset chopper neurons. We set out to distinguish between these possibilities by using classical collision techniques to distinguish antidromic from synaptically-driven action potentials. The experiments were performed in guinea pigs anaesthetized with intraperitoneal sodium pentobarbitone (30mg/kg) and 0.15ml intramuscular Hypnorm (fluanisone, 10mg/ml and fentanyl citrate, 0.315mg/ml). During electrical stimulation, the animals were paralyzed by intramuscular administration of Pancuronium. Heart rate was continuusly monitored and regular supplementary doses of both anaesthetics were given throughout the experiment. Data from a small number of well-characterized onset chopper neurons, showed that action potential collision only occurred at delays that were either the same as, or shorter than the delay between shocks and shock-evoked spikes in the same neurons. This result is inconsistent with the electrically-evoked spikes being antidromic and strongly suggests that the axon collaterals of olivocochlear neurons exert excitatory synaptic effects on onset chopper neurons. Furthermore, the robust nature of the spiking to high rates of shocks suggests that the synaptic connection is a powerful one, giving rise to strong and comparatively secure excitation of this class of cochlear nucleus neurons.

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