Molecular characterization of cholinergic vestibular and olivocochlear efferent neurons in the rodent brainstem

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Abstract

The neural code from the inner ear to the brain is dynamically controlled by central nervous efferent feedback to the audio-vestibular epithelium. Although such efference provides the basis for a cognitive control of our hearing and balance, we know surprisingly little about this feedback system. This project has investigated the applicability of a transgenic mouse model, expressing a fluorescent protein under the choline-acetyltransferase (ChAT) promoter, for targeting the cholinergic audio-vestibular efferent neurons in the brainstem. We found that the mouse model is useful for targeting the vestibular efferents, which are fluorescent, but not the auditory efferents, which are not highlighted. This model enables, for the first time, physiological studies of the vestibular efferent neurons and their synaptic inputs. We next assessed the expression of the potassium channel family Kv4, known to generate transient potassium currents upon depolarization. Such potassium currents are found in auditory efferent neurons, but it is not known whether Kv4 subunits are expressed in these neurons or if Kv4 is present and has a function in the vestibular efferent neurons. Double labelling with anti-ChAT and anti-Kv4.2 or Kv4.3 demonstrates that the Kv4.3 subunits are abundantly expressed in audio-vestibular efferents, thus indicating that this subunit is a large contributor to the excitability and firing properties of the auditory efferent neurons, and most probably also in the vestibular efferent neurons. In addition, we also unexpectedly found a strong expression of Kv4.3 in principal cells of the superior olive, the neurons of which are important for sound localization.

Key words:
Vestibular efferents, olivocochlear efferents, principal cells, GFP, ChAT, superior olivary complex, Kv4.3, transient outward current, A-type current