"Morphological Study of Dbx1$^+$ Respiratory Rhythm -Generating Neurons in PreBötzinger Complex in Neonatal Mice"

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Abstract

Breathing behavior in mammals depends on a respiratory-related rhythm that is generated by glutamatergic neurons in preBötzinger complex (preBötC) that are derived from a single genetic line, which expresses the homeodomain transcription factor Dbx1 embryonically. To what extent the morphology influences or governs the function of Dbx1$^+$ neurons remains unknown. To elucidate the role of Dbx1$^+$ neurons, and specifically their morphology, in respiration, I comparatively analyzed morphologies of Dbx1$^+$ and non-Dbx1$^+$ neurons in the preBötC. Dbx1$^+$ and non-Dbx1$^+$ neurons were recorded in reduced brainstem slice preparations that generate fictive respiratory like motor activity *in vitro*. Each recorded neuron was dialyzed with biocytin, processed to reveal biocytin, imaged, and then digitally reconstructed. Detailed morphological analysis of these digital reconstructions showed that Dbx1$^+$ neuron dendrites branched minimally and were confined to the transverse plane, whereas more highly branched non-Dbx1$^+$ neuron dendrites spanned deeper rostrocaudally. Also, Dbx1$^+$ neurons showed contralateral axonal projections more often than non-Dbx1$^+$ neurons. Investigation of dendritic spatial pattern revealed that Dbx1$^+$ neurons did not have spines or protrusions, but non-Dbx1$^+$ neurons showed a considerably higher number of spines and protrusions close to the soma. The dendritic morphology and axonal projection pattern suggest that Dbx1$^+$ neurons are specialized for local network interactions that serve respiratory rhythm generation and non-Dbx1$^+$ neurons are designed to participate in long-range communication throughout the medullary respiratory network.