Neuroscience 2004 Abstract

Presentation Number:	517.7
Abstract Title:	Biophysical correlates of intrinsic and stress-induced morphological variability in lateral amygdaloid neurons: A computational study.
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Primary Theme and Topics	Synaptic Transmission and Excitability - Intrinsic Membrane Properties -- Modulation and plasticity of intrinsic membrane properties
Secondary Theme and Topics	Homeostatic and Neuroendocrine Systems - Stress and the Brain -- Cellular actions of stress
Session:	517. Plasticity of Intrinsic Membrane Properties III Poster
Presentation Time:	Monday, October 25, 2004 3:00 PM-4:00 PM
Location:	Convention Center Exhibit Hall, Poster Board O17
Keywords:	DENDRITE, MODELING, ELECTROPHYSIOLOGY, EXCITABILITY

Morphological and physiological characteristics of neurons located in the dorsolateral and two ventral subdivisions of the lateral amygdala (LA) have been compared in order to differentiate their roles in the formation and storage of fear memories (Alphs et al, SfN abs 623.1, 2003). Briefly, in these populations, significant differences are observed in input resistance, membrane time constant, firing frequency, dendritic tortuosity, numbers of primary dendrites, dendritic segments and dendritic nodes. In the present study, we perform computational simulations using NEURON to (i) build a model of representative LA principal cells in each of these subpopulations; and (ii) analyze the functional correlates of differences in their morphology with respect to intrinsic firing properties and synaptic integration. To this end, we build a model using three-dimensional reconstructions of LA pyramidal cells in each of the three subdivisions, by imposing eight ion channels (Na,KDR,KA,BK,KAHP,CaN,CaL,CaT) and comparing the simulation outcomes with electrophysiological data. Our simulations show that variations in intrinsic firing properties among populations may be controlled by active membrane properties rather than being a direct reflection of the morphological differences. We have previously reported that chronic stress induces dendritic hypertrophy in LA pyramidal neurons. We use the model developed here for analyzing the electrophysiological consequences of these variations. We systematically induced growth in dendritic arbors of neurons to replicate dendritic hypertrophy. Simulations using these model cells indicate that hypertrophy reduces intrinsic cell excitability. Our results quantitatively distinguish the biophysical correlates of morphological variations in (i) internal dendritic organization structure; and (ii) total dendritic length.

Supported by DBT,NARSAD,MH38774,MH58911

Sample Citation:

[Authors]. [Abstract Title]. Program No. XXX.XX. 2004 Neuroscience Meeting Planner. San Diego, CA: Society for Neuroscience, 2004. Online.