Handbook of Neurochemistry and Molecular Neurobiology

Development and Aging Changes in the Nervous System
Abel Lajtha (Ed.)

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Development and Aging Changes in the Nervous System

Volume Editors: J. Regino Perez-Polo and Steffen Rossner

With 48 Figures and 12 Tables
Animals share the challenge of maintaining an internal environment that is restricted to fairly low ranges of temperature, pH, and water content within a well-protected envelope while engaged in continuous exchanges with the environment in terms of gases, liquids, energy, even as movement of body parts and the entire organism itself is necessary for survival. This dynamic spectrum of changes is further amplified during developmental events or more acutely during responses to pernicious environmental factors in due to trauma and disease. In addition, persistent incidents associated with aging can result in irreversible changes to the allostasis that characterizes the living condition.

In the nervous system, a very high metabolic turnover, fragile but steep ionic gradients, and morphological and structural constraints dictated by the necessity for prompt neuronal transmission of electrical impulses and necessary plasticity result in a highly fragile organ system.

Here we address a small sampling of major constituents of neural function at the cellular and molecular level that play important roles in development and aging, two endogenous processes that embody features of allostasis or the dynamic shifts in set points for specific homeostatic mechanisms associated with development and aging.

The opening chapters discuss the major players in the neurotrophic hypothesis, the neurotrophins. These growth factors have been shown to play a significant role during development and in the maintenance of the adult cholinergic system in CNS as well as in the development of the sensory and sympathetic nervous system. That they are also involved in plasticity events associated with memory and behavior points to the degenerate nature of signaling molecules that achieve specificity by acting in concert as part of ensembles of molecules rather than solitary regulators.

It is widely known that oligodendroglia and myelination events are late arrivals in the developmental scheme of the brain and are also prime targets in early development of ischemic insults. Thus, a chapter on oligodendroglia and myelination in development and aging serves to introduce these nonneuronal partners vital to proper neuronal transmission. Molecular participants in stress responses to both acute and chronic stressors are discussed from different perspectives in following chapters with varying degrees of emphasis on injury versus normal aging and neurodegenerative disease.

The study of neural responses to stress of various kinds has led to a realization of the importance of plasticity and the complexity of the mechanism allowing plasticity in the nervous system. The chapters addressing the topic are followed by an introduction to the amyloid hypothesis, and what may be its central character the enzyme held mostly responsible for the generation of beta amyloid. This is followed by a broader discussion of misfolding proteins in the nervous system and its possible interventions to counteract aging-associated deficits.

Limited in scope but offering a broad sampling, these chapters stress the dynamic features of neuronal responses to internal (developmental) cues or the more harmful external events (injury and disease) in a modern perspective.
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