

## Preface

---

To function properly, neurons cannot tolerate fluctuations of their local environmental variables. This mainly results from their high degree of specialization in synaptic integration and action potential conduction. Even small changes of certain extracellular ion concentrations, as well as in the dimensions of the extracellular space, alter ion channel kinetics in such a way as to distort the information represented by the nerve impulses. Another potential problem is the huge consumption of glucose and oxygen by neurons caused by the heavy compensatory ion pumping used for counteracting passive ion flux. This problem is compounded by the low glucose storage capacity of the neurons. A complicated structure surrounds the neurons to sustain the required level of metabolites and to remove waste products.

*The Neuronal Environment: Brain Homeostasis in Health and Disease* examines the function of all the components involved, including their perturbation during major disease states, and relates them to neuronal demands. The two introductory chapters focus on neuronal requirements. The dependence of their excitability on external factors that accumulate in the extracellular space, as well as their varying demands for energy metabolites, are described. Following that, the close interaction of neurons with elements of their microenvironment is illustrated. The extracellular space is no longer seen as a passive constituent of the CNS, but as a separate compartment in its own right, as a communication channel, and an entity that reacts with plastic changes in its size that will affect the concentrations of all its contents. Astrocytes participate in many neuronal processes, particularly in the removal of excess waste and signal substances, the supply of energy metabolites, and the modulation of synaptic transmission. In addition to their homeostatic role, astrocytes are now seen as an active partner involved in synaptic transmission between neurons. The classical example of a close relationship of neurons with a component of their environment is, of course, their relationship with the surrounding myelin sheath. This speeds up action potential conduction, but is itself a potential source of problems in various disease states. In the last few years new imaging techniques have demonstrated a close coupling between local blood flow and neuronal activity, and several theories have been put forward to explain these interactions. The special status of the brain in having its own insulated circulation system—the cerebrospinal fluid contained in the ventricles and ducts—is also underlined. The brain is the only organ that is protected from fluctuations of blood-borne chemicals by the existence of the blood–brain barrier. However, windows exist in this barrier in the form of the circumventricular organs that allow direct two-way communication between neurons and blood constituents. Finally, despite their protection and insulation, the neurons are accessible to the immune system. Resident macrophages and invasion by blood-borne immune cells that cross the endothelial cell barrier enable

an immune reaction to take place. This complex interaction of neurons with their immediate environment is integral to the tasks that the neurons must perform to ensure that the organism can cope with its environmental challenges. Most diseases originating in the brain start in these accessory systems of the neuronal microenvironment and affect neurons only second hand. Therefore, understanding the elements of the neuronal environment and the interactions with neurons, and with each other, is crucial in understanding the development and impact of most brain diseases.

All the authors contributing to *The Neuronal Environment: Brain Homeostasis in Health and Disease* have made an attempt not only to explain the normal functioning of these accessory elements, but also their involvement in major diseases. Therefore, this book not only addresses researchers, graduate students, and educators who want to understand the complex environment of neurons, but also health professionals who need to know more about the normal homeostatic role of the neuronal environment to follow disease patterns.

**Wolfgang Walz**



<http://www.springer.com/978-0-89603-882-0>

The Neuronal Environment

Brain Homeostasis in Health and Disease

Walz, W. (Ed.)

2002, X, 432 p., Hardcover

ISBN: 978-0-89603-882-0

A product of Humana Press