Methods in Molecular Biology

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Preface

The Nobel laureate and neurobiologist Eric Kandel once described neuroscience as the “last frontier” of science. Nervous system development evolves from the well-orchestrated processes of neural induction, cell proliferation, differentiation, cell migration, survival, and synapse formation. This complex machinery responds to a multitude of environmental cues, among these being neurotrophic factors: secreted proteins that promote neurite outgrowth, neuronal cell differentiation, and survival both in vivo and in vitro. Nerve growth factor (NGF) is the founding and best characterized member of the neurotrophin family of neurotrophic polypeptides and was discovered almost six decades ago by the pioneering Italian neurobiologist Rita Levi-Montalcini who, together with Stanley Cohen, was awarded the Nobel Prize for Medicine in 1986. NGF emerges as a complex pleiotropic agent active on a surprisingly broad spectrum of cell populations and biological functions within and outside the nervous system, a behavior which could not have been envisaged on the basis of early studies that established its trophic role for sensory and sympathetic neurons during development and adulthood. Since their initial discovery, neurotrophic factors have raised expectations that their clinical application to neurodegenerative diseases might provide an effective therapy for what are now untreatable conditions.

Exploring nervous system function and dysfunction is oftentimes impractical in humans, and the availability of ex vivo and in vivo models which mimic, as closely as possible, how neural cells act and interact among themselves is of critical importance in neurobiological research. This volume of *Methods in Molecular Biology* aims to provide the reader, specialist, and novice, alike, with a selection of protocols and procedures utilizing cellular, tissue, and whole animal models that can be applied to the investigation of neurotrophic factors and other agents impacting on these systems. This volume starts off with a number of chapters on the culture of neurons and glia from the central and peripheral nervous systems, neuron-glia and glia-glia coculture models, oligodendrocytes, and cell-based assays for the evaluation of cell vitality. This second edition book has evolved to also cover methodology encompassing site-specific direct labeling of neurotrophins and their receptors, angiogenesis assays, stem cells, pancreatic beta-cells, axonal transport, synapse biology, dendritic spine analysis, and brain endothelial cells. Subsequent chapters are dedicated to in vivo lesion models of relevance to nervous system pathology, which can be applied to the investigation of neurotrophic factors and peptides. Lastly, we close with protocols describing nanofiber- and nanoparticle-based methods for brain delivery of neurotrophic agents.

I would like to extend my sincere thanks to all the contributors for their excellent cooperation and patience during the course of this project. While extensive, this volume is by no means intended to be all-inclusive, given the field’s rapid progress and publication space limitations. Even so, I sincerely hope this book will be useful to a wide audience of readers as they explore nervous system function and pathology.

*Padova, Italy*  
*Stephen D. Skaper*
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