

NEUROMETHODS

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Neuromethods publishes cutting-edge methods and protocols in all areas of neuroscience as well as translational neurological and mental research. Each volume in the series offers tested laboratory protocols, step-by-step methods for reproducible lab experiments and addresses methodological controversies and pitfalls in order to aid neuroscientists in experimentation. *Neuromethods* focuses on traditional and emerging topics with wide-ranging implications to brain function, such as electrophysiology, neuroimaging, behavioral analysis, genomics, neurodegeneration, translational research and clinical trials. *Neuromethods* provides investigators and trainees with highly useful compendiums of key strategies and approaches for successful research in animal and human brain function including translational “bench to bedside” approaches to mental and neurological diseases.

Nanomedicines for Brain Drug Delivery

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Preface to the Series

Experimental life sciences have two basic foundations: concepts and tools. The *Neuromethods* series focuses on the tools and techniques unique to the investigation of the nervous system and excitable cells. It will not, however, shortchange the concept side of things as care has been taken to integrate these tools within the context of the concepts and questions under investigation. In this way, the series is unique in that it not only collects protocols but also includes theoretical background information and critiques which led to the methods and their development. Thus it gives the reader a better understanding of the origin of the techniques and their potential future development. The *Neuromethods* publishing program strikes a balance between recent and exciting developments like those concerning new animal models of disease, imaging, in vivo methods, and more established techniques, including, for example, immunocytochemistry and electrophysiological technologies. New trainees in neurosciences still need a sound footing in these older methods in order to apply a critical approach to their results.

Under the guidance of its founders, Alan Boulton and Glen Baker, the *Neuromethods* series has been a success since its first volume published through Humana Press in 1985. The series continues to flourish through many changes over the years. It is now published under the umbrella of Springer Protocols. While methods involving brain research have changed a lot since the series started, the publishing environment and technology have changed even more radically. Neuromethods has the distinct layout and style of the Springer Protocols program, designed specifically for readability and ease of reference in a laboratory setting.

The careful application of methods is potentially the most important step in the process of scientific inquiry. In the past, new methodologies led the way in developing new disciplines in the biological and medical sciences. For example, Physiology emerged out of Anatomy in the nineteenth century by harnessing new methods based on the newly discovered phenomenon of electricity. Nowadays, the relationships between disciplines and methods are more complex. Methods are now widely shared between disciplines and research areas. New developments in electronic publishing make it possible for scientists that encounter new methods to quickly find sources of information electronically. The design of individual volumes and chapters in this series takes this new access technology into account. Springer Protocols makes it possible to download single protocols separately. In addition, Springer makes its print-on-demand technology available globally. A print copy can therefore be acquired quickly and for a competitive price anywhere in the world.

Saskatoon, SK, Canada

Wolfgang Walz

Preface

Nanomedicines have revolutionized research on drug delivery in multiple diseases, and leading strategies have achieved clinical success. Moreover, a significant number of clinical trials are conducted to continue expanding the reach of nanomedicines to new, more effective and with less side effects therapies. The central nervous system (CNS) has similarly been the focus of extended research in the design and evaluation of novel nanocarriers for brain drug delivery. As a target site, the CNS represents a unique challenge given its anatomy and physiology. The blood brain barrier (BBB) is not only a restrictive limitation for systemically administered drugs but also continues to be a largely restrictive barrier to achieve significant CNS nanocarrier bioavailability. While the BBB represents one of the main limitations for significant CNS biodistribution, overcoming it is not the sole reason for limited bioavailability and targeting effects. Successfully targeting the brain microvasculature, distribution through the CNS (after passage through the BBB), and internalization in target brain cells become important challenges once there is a BBB penetration strategy in place.

As such, this book will be a source for finding the latest research in CNS-targeted nanocarriers, methods for their synthesis and thorough characterization. Moreover, a chapter addressing toxicity aspects to be considered in the design and use of brain-targeted nanocarriers will be of interest to the reader. The first two chapters of the book delve into the most widely investigated nanocarriers as brain-targeted delivery systems, i.e., polymeric nanoparticles and liposomes. With a thorough description of the state of the art as well as key aspects of their characterization, the first two chapters also highlight physiological properties relevant to particle design. Chapter 4 depicts the use of self-assembled peptide-based scaffolds for lesions of the nervous system, while Chapter 5 describes not only the use of peptides as CNS drugs but also as potential carriers to optimize brain-targeted delivery. Chapters 6 and 7 describe inorganic and magnetic nanoparticles used for targeting drugs to the CNS as well as their potential in the design of triggerable and aimed systems. Chapter 8 inspects the long-researched nose-to-brain delivery route, highlighting its potential and how the limitations this route presents could be addressed to harness its clinical potential. Chapter 9 is an excellent compilation of characterization methods to model and assess BBB absorption of drugs and drug delivery systems, and as such, this chapter will be of great use to scientists designing brain-targeted delivery systems to predict brain distribution. Finally, Chapter 10 presents the concerns that the use of nanomaterials raises in the context of brain-targeted systems. As such, the last chapter will be a good source to understand the potential neurotoxic effects and the potential role of nanomaterials in neurodegeneration progress.

The editors are immensely grateful to all the individual contributions and authors for sharing their time, effort, and knowledge to create this book. Their outstanding work in the fields covered in this book we hope will be of great interest to the reader and will help guide and move forward the field of nanomedicines to target the brain and the nervous system.

Santiago, Chile
Leiden, The Netherlands

Javier O. Morales
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