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## Preface

While blood vessels in the adult central nervous system are extremely stable under normal conditions, it is now accepted that these vessels can be rapidly remodeled in a variety of physiological and pathological situations, including cerebral hypoxia, cerebral ischemia, and tumor development. All of these conditions trigger cerebral angiogenesis, i.e., the sprouting of new vessels. In light of the critical importance of cerebral angiogenesis in promoting physiological adaptation (hypoxia), recovery (cerebral ischemia), or pathogenesis (brain tumors), it becomes a high priority to fully understand the molecular mechanisms underlying this process. In the last 20 years, we have tremendously expanded our working knowledge of how vascular remodeling in the brain occurs and identified many of the key cellular and molecular events underlying this process. From a clinical viewpoint, clear goals are to promote angiogenesis following ischemic stroke or block angiogenic remodeling during brain tumor formation. However, we are still some way off from achieving these noble aims, and it is likely that only after more intensive research and studies, based on the kind of principles and experimental approaches outlined in this volume, will these goals be realistically attainable.

In light of the rapidly expanding field of cerebral angiogenesis, the aim of *Cerebral Angiogenesis: Methods and Protocols* is to provide a selection of the key techniques that are used in characterizing cerebral angiogenesis and to define the cellular and molecular mechanisms underlying this important process. Following the objective of the highly successful *Methods in Molecular Biology* series, the aim of this book is to provide a comprehensive step-by-step guide for the many models and techniques for studying cerebral angiogenesis as well as more specialized approaches for examining endothelial cell behavior, both in vitro and in vivo. As such, *Cerebral Angiogenesis: Methods and Protocols* should help all researchers, both those new to this field as well as those looking to use more specialized and sophisticated techniques, to examine blood vessel growth in the brain. *Cerebral Angiogenesis: Methods and Protocols* covers a wide range of protocols, which provide a useful resource for vascular biologists, cell biologists, molecular biologists, and neuroscientists. This book is divided into six parts. Part I provides an overview of cerebral angiogenesis occurring in different scenarios. Part II describes a variety of different models in which cerebral angiogenesis can be studied as well as includes one chapter describing cerebral arteriogenesis, the formation of new functional arteries. Part III presents a number of methods to characterize and quantify angiogenic events as well as several different approaches to measure changes in cerebral blood flow. Part IV describes different approaches to investigate the role of specific candidate genes in cerebral angiogenesis as well as an important method to determine the contribution of blood-derived hematopoietic stem cells. Part V presents several methods of therapeutically manipulating cerebral angiogenesis by gene delivery. Finally, Part VI outlines some important approaches to examine cerebral angiogenic mechanisms in vitro, including primary culture of brain endothelial cells from different species, assays to examine different aspects of endothelial cell function, and cell culture systems to examine blood vessel formation in vitro. It also includes two chapters that describe in vitro systems of the blood–brain barrier.

I hope that all readers, both first year graduate students and experienced investigators, will find *Cerebral Angiogenesis: Methods and Protocols* to be both timely and useful in their research endeavours. I would like to thank all contributors for their valuable time and effort spent in preparing these excellent chapters and for passing on the critical steps and snippets of experimental knowledge, painstakingly acquired over many years in the laboratory, that can make all of our lives that much easier. My sincere thanks also go to John Walker for giving me the opportunity to put this collection together and for providing editorial assistance during the preparation of this book.

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