Glial Cell Engineering in Neural Regeneration

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Preface

Neural tissue damage may result in lifelong disabilities and represents a considerable public burden. Advances in therapeutic approaches during the past few decades offer hope for such victims. However, the limited functional improvement in in vivo studies hinders effective application of therapeutic strategies in clinical practice due to the complexity of the nervous system. Very little spontaneous regeneration, repair, or healing occurs in the central nervous system. Neural tissue engineering that combines treatments of cell therapy, transplantation of biomaterial scaffolds, genetic manipulation, and electrical stimulation is one of the most promising methods to restore function of nervous system.

Glia play a pivotal role in maintaining the structural integrity and physiological function of the neurons. Glia are a fundamental cell type for the control of several critical activities of nervous system, such as myelination, synaptic transmission, and homeostasis. They are also involved in all types of pathological processes of the nervous system, including acute lesions such as trauma or stroke and chronic neurodegenerative disease. Glia transplantation may enhance functional recovery of a damaged nervous system by myelinating axons, providing trophic support, and promoting endogenous regeneration.

This book summarizes the advance of the research of glia function in neural regeneration and glia–biomaterials interaction. This book also reviews a unique function of electric fields in axonal growth, neural cell migration and division, and stem cell differentiation. The major contents of this book include the following: advances in the research of astrocyte function in neural regeneration (Chapter 1, by Madhulika Srikanth, Li Yao, and Ramazan Asmatulu); enhancement of axonal myelination in wounded spinal cord using oligodendrocyte precursor cell transplantation (Chapter 2, by Li Yao and Michael Skrebes); application of Schwann cells in neural tissue engineering (Chapter 3, by Li Yao and Priyanka Priyadarshani); stem cell- and biomaterial-based neural repair for enhancing spinal axonal regeneration (Chapter 4, by Pranita Kaphle, Li Yao, and Joshua Kehler); electric field-guided cell migration, polarization, and division: an emerging therapy in neural regeneration (Chapter 5, by Li Yao and Yongchao Li); vascularization in the spinal cord: the pathological process and therapeutic approach (Chapter 6, by Hien Tran and Li

Yao). I would like to acknowledge my laboratory members and colleagues for their contribution to this book.

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