

# The Preface

Stroke and injuries in the central nervous system (CNS) such as traumatic brain injury and spinal cord injury are the leading causes of long-term disability worldwide. During the past several decades, great efforts have been made to understand the pathological process and develop therapeutic strategies for reducing neuron loss and improving functional restoration after stroke or CNS injuries. Accumulating evidence has revealed that the pathological process after stroke and CNS injuries is orchestrated in a very complex manner throughout the acute, subacute and chronic phases. A large number of molecules, proteins and cells both inside and outside the CNS are crucially involved in the events occurring from initiating stroke and CNS injuries to recovery from the injuries; these events include oxidative stress, inflammatory, neuroprotection, dead tissue removal, neurogenesis, angiogenesis, and neural network rewiring. Learning from the lessons that thousands of drugs targeting a signal molecule, protein or cell failed in clinical trials, combinational therapies targeting multiple molecules, proteins or cells have recently been proposed to be the new direction for developing treatment for stroke and CNS injuries.

The Cellular Therapy for Stroke and CNS Injuries was chosen as the theme of this book because a large body of evidence suggests that stem cell therapy would be a good candidate to meet the new mission of searching for treatment for stroke and CNS injuries. Numerous studies have demonstrated that stem cells can release neuron trophic factors, growth factors, and anti-inflammatory cytokines in situ, which protect neurons from injuries, reduce inflammation, and enhance neurogenesis, angiogenesis, and neuronal network remodeling in the recipient CNS after transplantation. Importantly, recent studies have demonstrated that stem cells also release abundant exosomes and microvesicles (EMVs), which contain membrane receptors, proteins, mRNAs, miRNAs and organelles. Stem cell-derived EMVs have been shown to rescue cells from injury, reprogram terminally differentiated cells to re-enter the cycle, and promote tissue regeneration and repair. Although transplantation of neural stem cells or bone marrow stem cells has moved to clinical trials, many open questions in basic stem cell research still remain to be addressed in future. Further studies needed in future include mechanistic elaboration of stem cells in rebuilding the neurovascular unit and in neuroprotection and neurorepair in the settings of stroke and CNS injuries, limitation of stem cell passages before

transplantation, refined methods for culturing stem cells *ex vivo* or *in vitro*, the optimal timing, route and dose of stem cell delivery, the frequency of stem cell therapy, and the combination of stem cell therapy with other treatments.

Many investigators in the world, especially those who have given important contributions to the field of stem cell research and stem cell therapy, were invited to create the chapters of this book. In these chapters, the development of stem cell therapy and new advances in stem cell research and therapies for stroke and CNS injuries have been summarized, and challenging questions and future directions have been discussed. This book is organized by several sections divided by stem cell types. We believe that the readers of this book will obtain new knowledge on the progress in stem cell research and therapy for stroke and CNS injuries, will get new insights into how the current approaches can be improved, and will find the gaps to advance this research field to a deeper level.

We would greatly appreciate all the contributors for each of the chapters. Obviously without their support and contributions, the creation of this book would not have been possible.

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