American population is aging and an increasing number of Americans are afflicted with stroke, spinal cord trauma, traumatic brain injury, and neurodegenerative diseases. These neurological conditions result in the acute as well as gradual and progressive neurodegeneration, which leads to brain dysfunction. Known risk factors for stroke and neurodegenerative diseases include increasing age, genetic polymorphisms, endocrine dysfunction, oxidative stress, neuroinflammation, excitotoxicity, hypertension, infection, and exposure to neurotoxins. In contrast, spinal cord trauma and traumatic brain injury due to motor cycle and car accidents are major causes of death and disability among young people below the mid-thirties in the USA. According to the NINDS approximately 30–40 million Americans are affected by stroke and neurodegenerative diseases each year. The number of people affected with neurological disorders will double every 20 years and will cost the US economy billions of dollars each year in direct health-care costs and lost opportunities. As the baby boomer’s generation ages and the prevalence of neurotraumatic and neurodegenerative diseases increases in the American society, the need to confront and solve the present day health-care crisis becomes more critical than ever before. In fact, there is now an urgent need to expand significantly the national and international efforts to solve the problem of neurotraumatic and neurodegenerative diseases, with special emphasis on prevention. It is estimated that $100 billion/year will be spent on Alzheimer disease alone. In addition to the financial cost, there is an immense emotional burden on patients, their relatives, and caregivers.

Although molecular mechanisms associated with the pathogenesis of neurotraumatic and neurodegenerative diseases remain unknown, oxidative stress, excitotoxicity, inflammation, misfolding, aggregation, and accumulation of proteins, perturbed Ca^{2+} homeostasis, and apoptosis have been implicated as possible causes of neurodegeneration in the above neurological disorders. There have been remarkable developments not only on neurochemical aspects but also on target-based pharmacological therapeutic intervention in neurotraumatic and neurodegenerative diseases in a variety of animal and cell culture models in past 20 years. In the clinical setting, however, these treatments have failed not only due to the heterogeneity (occurrence of neurons, astrocytes, oligodendrocytes, and microglial cells) of brain and spinal cord tissues but also because degenerating neurons and injured
axons within brain and spinal cord are unable to regenerate spontaneously. The therapeutic strategies to re-establish lost neuronal connections in neurotraumatic and neurodegenerative diseases are currently unavailable. The main objective of this monograph is to present readers with cutting edge and comprehensive overview on neurochemical aspects of neurotraumatic (stroke, spinal cord trauma, and traumatic head injury) and neurodegenerative diseases (Alzheimer disease, Parkinson disease, Amyotrophic Lateral Sclerosis, Huntington disease, and prion disease) in a manner that is useful not only to students and teachers but also to researcher scientists and clinicians. This monograph has 10 chapters. Chapter 1 deals with molecular mechanisms associated with neurodegenerative processes in the brain and spinal cord. Chapters 2 and 3 describe molecular mechanism of neurodegeneration in stroke and potential therapeutic approaches for the treatment of ischemic injury in the brain. Chapters 4 and 5 describe cutting-edge information on neurochemical mechanisms of secondary injury in spinal cord trauma and potential therapeutic strategies for spinal cord injury. Chapters 6 and 7 describe molecular mechanism and treatment strategies for traumatic brain injury. Chapters 8 and 9 describe potential molecular mechanisms associated with the pathogenesis of neurodegenerative diseases and progress on pharmacological approaches that can be used for the treatment of neurodegenerative diseases. Finally, Chapter 10 provides readers and researchers with perspective that will be important for the future research work on neurotraumatic and neurodegenerative diseases in brain and spinal cord.

This monograph can be used as supplemental text for a range of neuroscience and neurochemistry courses. Clinicians (neurologists, pathologists, and psychiatrists) will find this book useful for understanding molecular aspects of neurotraumatic and neurodegenerative diseases. These topics fall in a fast-paced research area related to neurodegeneration that provides opportunities for target-based therapeutic intervention. Although many edited books are separately available on molecular mechanism of stroke, spinal cord trauma, traumatic brain injury, and neurodegenerative diseases but, to the best of my knowledge no one has written a monograph on the neurochemical aspects of neurotraumatic and neurodegenerative diseases. The present monograph is the first to provide a comprehensive and comparative description of neurochemical changes in stroke, spinal cord trauma, traumatic brain injury, and various neurodegenerative diseases along with progress on their pharmacological therapy. This monograph not only provides background and refresher information on neurotraumatic and neurodegenerative diseases in the brain and spinal cord to readers not working in this field but also presents a thorough and unique overview on progress that has been made on the neurochemistry and treatment of stroke, spinal cord trauma, traumatic brain injury, and various neurodegenerative diseases for researcher scientists, who are actively working in the field of neurodegeneration.

The choices of topics presented in this monograph are personal. They are based on my interest not only in the neurochemistry of stroke, spinal cord injury, traumatic brain injury, and various neurodegenerative diseases but also in areas where major progress has been made. I have tried to ensure uniformity and mode of presentation as well as a logical progression of subject from one topic to another and
have provided extensive bibliography. For the sake of simplicity and uniformity a large number of figures with chemical structures of drugs used for the treatment of above neurological disorders and line diagrams of colored signal transduction pathways are also included. I hope that my attempt to integrate and consolidate the knowledge on the neurochemistry of neurotraumatic and neurodegenerative diseases will provide the basis of more dramatic advances and developments not only on molecular mechanisms but also on causes and treatment of neurotraumatic and neurodegenerative diseases.

Columbus, Ohio

Akhlaq A. Farooqui
Neurochemical Aspects of Neurotraumatic and Neurodegenerative Diseases
Farooqui, A.A.
2010, XXIII, 401 p., Hardcover
ISBN: 978-1-4419-6651-3