Modern Neurosurgery: Clinical Translation of Neuroscience Advances
Advances in clinical neuroscience often arise from a better understanding of brain function and hypotheses based at the cellular, system, or organ level. Recent emphasis is on translating functions or structure-based hypotheses into clinical treatment schemes. This process of translational research depends on a number of critical steps, and in most cases, a clinical market that would make commercialization worthwhile financially. Rather than focus on current treatment schemes, this volume will critically discuss treatments in the process of development, particularly those that have arisen or will arise from advances in neuroscience knowledge. The three categories of such treatments are: (1) treatments, aids, and techniques currently in clinical trials or pending U.S. Food and Drug Administration (FDA) approval and new indications for older approved drugs and devices; (2) advances in the promising preclinical stages that may lead to a rapid progression to initial human trials over the next 5 to 10 years; and (3) approaches that failed at the clinical application level, but still offer insights into whether the initial hypothesis was invalid or significantly flawed in some respect.

Many of these advances are hypothesis-based, particularly the pharmacological approaches. However, as a surgical specialty, neurosurgery also has experienced many technical advances, both in terms of treatment and also for both diagnostic approaches and aids that enhance the technical performance of surgical procedures. Such technical advances have led the FDA to devise new methods of approval for approaches that do not directly entail treatment, for example, aids to performance of the surgery. Such aids include stereotactic frames, frameless computer-guided approaches, diagnostic ultrasound, operating microscopes, and many other devices that highlight the dominant role that technological advances continue to exert in translating neuroscience into clinical practice. However, even the application of a new technology requires the identification of a hypothesis. Clear specification of the underlying hypothesis and associated supportive data may lead logically to identifying required testing and enhancement of data both for and against a concept.

This book intends to examine the interface between neuroscience progress and clinical neuroscience advances by assessing the hypotheses that drive this evolution. With this hypothesis-based approach, this book will review the relevant neuroscience underpinnings of new neurosurgical techniques, treatments, and conceptual approaches that are likely to shape clinical neuroscience over the next decade. This dynamic approach is a radical departure from more descriptive books on the topic of 21st century neurological sciences that focus on reviews of current techniques or treatment schemes with timelines to clinical application greater than 10 years.

The specific charge to all the chapter authors was to outline and discuss advances in clinical neurosciences that may occur over the next 5 to 10 years, but are not yet clinical realities. This horizon includes treatment schemes that may be in early stages
of clinical adaptation, but the goal is to depart from a review of current clinical practice. As these advances progress in their translation into clinical practice, clearly many may not pass the critical steps of possessing sufficient safety, efficacy, market potential, and usefulness to become marketable items or common practices. Many excellent concepts developed over the past 10 years failed to generate impacts as clinical solutions because of unanticipated problems arising in the translation, even though the underlying hypotheses driving the concepts were excellent. Such concepts include multiple forms of percutaneous discectomy approaches, the clinical use in surgery of laser tumor removals and intraventricular glial-derived neurotrophic factor (GDNF) for Parkinson’s disease. We are hopeful that we have chosen wisely — that we will not highlight a collection of “white elephant” approaches, but rather will illustrate broader principles of hypothesis-based neuroscience advances.
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