
Preface

The motivation for writing this book was the perceived need on the part of my neuroradiology trainees and colleagues at Johns Hopkins, as well as on the part of some of my neurosurgical and neuro-oncology colleagues, for a comprehensive but concise overview of current state-of-the-art clinical functional/physiologic imaging of brain tumors. Although innumerable research applications have been developed over the last couple of decades in the areas of blood oxygen level-dependent (BOLD) functional magnetic resonance imaging (fMRI), diffusion tensor imaging (DTI), magnetic source imaging/magnetoencephalography (MEG/MSI), MR perfusion imaging and magnetic resonance spectroscopic imaging (MRSI), no single book has been published to date that describes the clinical applications of all of these modalities as they relate specifically to brain tumor imaging. Furthermore, newer more advanced functional imaging techniques, such as sodium imaging at ultra-high field, amide proton transfer (APT) imaging, molecular imaging and high angular resolution diffusion imaging (HARDI), which are generally currently considered to be strictly research level, have found limited clinical application in some settings, and these newer modalities hold much promise for the future of brain tumor imaging. As such, I believe that our colleagues in neuroscience-related fields should be aware of these emerging modalities as well. To date no single book has ever attempted to bring together all of these seemingly disparate imaging modalities to explain how these are currently applied to brain tumor imaging, let alone explain how these may find future application. Thus, although the title of the book suggests an emphasis on BOLD fMRI, I prefer to consider “functional imaging” in its broader context as physiologic imaging. I believe that this book provides a unique conglomeration of descriptions of different techniques that enable physicians in neuro-oncology, neurosurgery, and neuroradiology the opportunity to examine the actual tumor biology and physiology rather than simply rely on current structural MR imaging, which provides very nonspecific information regarding de novo histology, overall prognosis, and therapeutic response. My hope is that understanding of these physiologic imaging modalities and their current applications will serve as a catalyst for future generations of physicians and scientists to build upon what is currently available to improve the overall standard of care for these patients. This book should be useful also to medical students and researchers in the neurosciences who want to quickly

learn about what is currently state of the art in physiologic brain tumor imaging as described by those who are recognized leaders in their respective fields, without having to search through countless research papers to build a foundation of knowledge related to these emerging technologies.

The book is divided into three sections. The first deals primarily with the diagnosis and characterization of brain tumors, with three chapters devoted to MR perfusion imaging, DTI, and MRSI, respectively. The second section deals with applications of physiologic/functional imaging to treatment planning and monitoring of therapeutic intervention. This section contains a total of six chapters, including two chapters on BOLD imaging for presurgical mapping (one covering language function and another motor function), one chapter on DTI for presurgical mapping, one on MEG/MSI applications to neurosurgery, one on PET imaging of brain tumors, and one on MRSI of brain tumors. The last section covers future directions in physiologic brain tumor imaging. This last section includes five chapters covering the following topics: APT, HARDI, and other advanced diffusion imaging for surgical planning, ultra-high field MRSI, sodium MRI for the management of human high-grade brain tumors, and future clinical applications of molecular imaging.

The planning and generation of this manuscript required three years of effort to compile contributions from many of the renowned experts in functional imaging, and striking the right balance of descriptions of clinical applications and future potential proved to be challenging. Furthermore, the rapidly evolving nature of these fields made it even more challenging to provide an overview that is truly up-to-date. Much of the current work in genomics and connectomics is extremely preliminary and has not yet found its application in brain tumor imaging, and thus these aspects have been deliberately omitted from this first edition, but as their contributions emerge in the near future, attempts will be made to incorporate them into future editions. It is for this reason that resting state fMRI and diffusion spectrum imaging have been avoided, although these are currently active areas of functional imaging research, both at my institution and across many others in the United States and abroad. However, description of the basics of molecular imaging has been included, because this is one area where clinical translation with respect to brain tumors in the very near future is likely. The authors of the respective chapters and I hope that the readers of this unique volume find the contents to be both enlightening with respect to research applications and clinically useful at the same time. In the end, pragmatic concerns trumped the need to include esoterica, and thus both clinicians and scientists in neuroscience fields will hopefully share my own perspective and find this to be an important contribution to the brain tumor imaging literature that will serve to advance both patient care and research in this rapidly developing field.

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