Molecular and Cellular MR Imaging

M.M.J. Modo and J.W.M. Bulte, eds.

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The application of histology and molecular biology in humans is very restricted. Neither can provide a satisfactory noninvasive deep-tissue visualization of molecules or cells in living organisms. The development of molecular and cellular imaging aims to bridge this gap and provide methods that allow the detection of molecules and their interaction in living organisms over time. The specificity to particular molecules or cells differentiates molecular and cellular imaging from more conventional imaging techniques. It is thus the target and not necessarily the technique that differentiates molecular or cellular imaging from conventional imaging.

The ability of molecular and cellular imaging to track the survival, migration, and differentiation of cells in vivo and to monitor particular gene expression in living subjects is rapidly moving from the research laboratory into daily clinical settings.

The interdisciplinary nature of the field mandates a constant dialogue among molecular and cellular biology, chemistry, physics, image analysis, and drug discovery to develop and translate promising approaches into reliable scientific applications and viable clinical diagnostic tools. From molecular to functional imaging, the diversity of information provided by MRI is unparalleled by other techniques. It is foreseeable that MRI will increasingly become the core integrative technology in biomedicine.

Molecular and cellular MRI has recently emerged as a novel technology for the noninvasive assessment of biologic processes in living organisms and has substantially progressed in the past few years. The possibility of tracking the survival, migration, and differentiation of cells in vivo, and the ability to monitor particular gene or protein expression in living subjects, not only is becoming of great interest to scientists investigating fundamental aspects of diseases but also is now finding a translation into clinical settings.

In this book, a selected group of internationally recognized authors, each drawing on specific expertise, highlights the diversity of skills necessary to further advance the field of molecular and cellular MRI. A constant dialog between these disciplines is vital to develop and translate promising approaches into reliable scientific applications and viable clinical diagnostic tools. This book provides a state-of-the-art overview of the various approaches to date that have been developed to visualize cells and molecules by MRI and illustrates the application of these approaches to the interrogation of specific processes in both animals and humans. Using a systematic organization to present diverse information, the text begins with an introductory chapter that defines cellular and molecular imaging and explains why MRI is the most versatile approach for noninvasive in vivo studies. This chapter is followed by 4 parts. Part I, with 6 chapters, examines the various contrast agents that are used in MRI, exploring both the physics and the chemistry involved. Part II, with 5 chapters, summarizes the wide variety of applications for the molecular imaging of genes and of a range of disease states. Part III, with 8 chapters, is devoted to cellular imaging, and part IV, with 2 chapters, discusses the translational aspects and future directions of cellular and molecular imaging.

Illustrations and tables are clear and help to aid the understanding of and to summarize messages, and references are updated.

This book will be useful to radiologists and radiologic scientists in reviewing updated molecular and cellular MRI, as well as in their research work. It should be placed in medical libraries for researchers who want to use MRI techniques to probe the evolution of biologic molecules in vivo and determine how these elements participate in diseases.

E. Edmund Kim
University of Texas M.D. Anderson Cancer Center
Houston, Texas

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