Imaging and Metabolism

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Editors

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Foreword for Imaging and Metabolism

The editors have assembled an impressive and timely synthesis of two of the most dynamic fields in medicine: molecular imaging and metabolism. Recent advances in positron emission tomography, magnetic resonance imaging, and optical imaging not only allow us to image the human body but also to interrogate its physiology. These advances are timely because the worldwide obesity epidemic has forced scientists and physicians to rethink basic concepts of cellular and organismal metabolism. The in vivo metabolic insights being provided by molecular imaging techniques have the potential to revolutionize the understanding of diabetes and obesity, as well as to provide new insight into cardiac disease and other metabolic syndromes. Molecular imaging techniques are also shedding new light on how cellular metabolism is altered during the pathogenesis of proliferative disorders (including cancer and autoimmunity) and degenerative disorders (including Alzheimer's disease and Parkinson's syndrome).

The authors of each of the chapters are leading investigators in the evolving field of metabolic imaging and how it can be applied to the study of disease. For the introductory reader, the early chapters introduce the principles underlining molecular imaging and their application to the disease-related studies of organismal and cellular metabolism. For more advanced readers, the book provides an excellent synthesis of how recent advances in PET, MRI, and optical imaging have combined to advance the field of molecular imaging in pursuit of a greater understanding of human physiology. The later chapters describe the in vivo uses of metabolic imaging in studying the pathogenesis of a wide variety of human diseases.

Collectively, the chapters of this comprehensibly prepared book make a compelling case that molecular imaging of metabolic processes will transform our ability to diagnose and treat traditional and nontraditional metabolic diseases. It is a must-read for investigators interested in imaging and/or metabolism.

Craig B. Thompson
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Preface: Imaging and Metabolism

Both Metabolism and Molecular Imaging have recently received an increased interest across many scientific communities—especially with the emergence of the personalized medicine paradigm and the desire to better understand disease processes in a nondestructive and noninvasive manner.

Molecular imaging, as its name implies, is a field that lies squarely at the nidus of molecular biology and traditional medical imaging and is situated at the intersection of various disciplines—biology, medicine, chemistry, physics, genomics, pharmacology, and engineering. Over the past two decades, two factors have acted in concert to fuel the ascent of molecular imaging in both the laboratory and the clinic: an increased understanding of the molecular mechanisms of disease and the continued development of in vivo imaging technologies, ranging from improved detectors to novel labeling methodologies. Taking cancer as an example, both the cellular expression of disease biomarkers and fluctuations in tissue metabolism and microenvironment have emerged as extremely promising targets for imaging. Indeed, the field has produced effective molecularly targeted agents applied with a wide variety of imaging modalities, from fluorescence and luminescence to nuclear imaging and magnetic resonance.

With molecular imaging as a means to probe the inner workings of a cell, metabolism represents the fundamental biochemical processes that facilitate life. In the past century, an immense literature has been established elucidating the interconnected reactions, which transform nutrients into building blocks and functional cellular components and generate energy. Interestingly, metabolic reactions can establish a steady state that provides differential cell function and when derailed, in response to genomic or environmental changes, can result in a wide range of disease phenotypes. Moreover, dynamic aberrations in metabolism can lead to epigenetic regulation of gene expression, further manipulating cell function and even potentially cell fate decisions. With a reemergence of metabolism to the forefront of biochemical research, novel molecular imaging tools allow for the ability to further connect disease states with their fundamental causes, *in vivo*.

In this book, we sought for the first time to combine the latest insights into metabolism with state-of-the-art imaging technologies. In the first part of the book, we introduce the reader to advanced molecular imaging techniques as well as to the metabolism field. We then focus in Part II on approaches available for imaging metabolism. We complete the book with the specifics of imaging diseases, which have a metabolic component, e.g., cancer, neurodegeneration,

diabetes, and fatty liver disease. The aim is to provide the reader with a multi-modality imaging compendium targeted at understanding metabolism from multiple viewpoints. Our overarching goal is for the first edition of this book to become a reference textbook for researchers interested in metabolism and the noninvasive tools that are available to interrogate aberrant metabolism in both the preclinical and clinical settings.

No work of this size can be achieved without significant help from some very special people. We would first like to thank all the contributors to this book—their efforts and work is very much appreciated. We would like to thank our postdocs and students for their insight and help reviewing and editing the chapters as well as Janet Folin and Karthik Periyasamy at Springer for their support and help. Finally, we would like to thank our better halves, Mikel and Parastou, for their patience and understanding while sitting through many evenings when we discussed planning this book over dinner.

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