Molecular Imaging of Small Animals: Instrumentation and Applications

H. Zaidi, Ed.

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The Society of Nuclear Medicine and Molecular Imaging defines molecular imaging as a type of medical imaging that provides detailed pictures of what is happening inside the body at the molecular and cellular level. Since molecular imaging has its roots in molecular/cellular biology and imaging technology, it has been exploited in biomedical research involving the use of small animals to visualize and track several molecular or chemical processes in vivo. In the past decade, significant progress has been achieved in the development of molecular imaging, especially in multimodality small-animal instrumentation. I read this book with great interest and found it to be the first comprehensive textbook focusing on small-animal molecular imaging instrumentation and applications. This book is edited by Habib Zaidi, professor and chief physicist of the Department of Radiology and Medical Informatics, Geneva University Hospital, Geneva, Switzerland. The chapters were written by around 50 active imaging physicists, radiochemists, researchers, and physician–scientists in the field.

The volume is divided into 25 chapters, mainly in 2 parts: instrumentation and applications. The first part begins by describing scintillation, solid-state, and photon detectors (chapters 1–3) and then continues with design considerations for small-animal SPECT, PET, CT, MR imaging, and optical imaging devices (chapters 4–8). In chapter 9, it also thoroughly reviews advances in radiotracer development for molecular imaging. This chapter is dedicated to Professor Michael Welch, who passed away before the book was published. Another thoughtful topic of this book is image registration for multimodality small-animal imaging (chapter 10). This topic is particularly important for beginners who need to know the principles and special considerations of image registration, since information derived from multiple modalities is often complementary. The book is well organized, covering dual-modality preclinical instrumentation such as SPECT/CT, SPECT/CT, PET/CT, SPECT/MR imaging, PET/MR imaging, and PET/optical imaging (chapters 11–16). Chapter 17, on quantification of small-animal imaging data, is written by the editor himself. It describes advances in image reconstruction strategies, scatter modeling and correction, attenuation compensation, partial-volume-effect correction, quantification and kinetic modeling, and future directions.

The second part of the book focuses on preclinical small-animal applications (chapters 17–24). It presents detailed instructions on animal handling and preparation and then extends to applications of molecular small-animal imaging in neurology and psychiatry, cardiology, oncology, inflammation and infection, gene expression, and drug development. Each chapter offers a detailed review of current applications and future perspectives, with high-quality color illustrations obtained from different imaging modalities. The last chapter (chapter 25), on the future outlook for multimodality molecular imaging, provides clinical perspective, promise, and the challenges of preclinical multimodality imaging and ends with future directions. The editor finally states that "multimodality small animal molecular imaging is an area of considerable research interest and many research groups are very active in this field, leading the molecular imaging community to predict a promising progress during the next few years."

One suggestion, should the authors decide to produce a second edition, is that the cited literature should be updated. According to the references, I assume that some of the chapters were completed before 2010. For example, the author of chapter 7 expected that Geiger avalanche photodiodes "will very likely happen within late 2009 or 2010."

Overall, the reader is guided through the fundamental concepts of instrumentation design, image registration and quantification, animal preparation, and various preclinical applications. The text is clearly presented in a "what for" and "how to" fashion and enriched by impressive illustrations and summary tables. The book not only can serve as an easy and quick introduction to beginners in the fields of imaging physics, research, and science but also can be an excellent teaching aid for students, researchers, and professionals in the fields of biomedicine, instrumentation, and drug development.

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