

**Radionanomedicine: Combined Nuclear and Nanomedicine**

D.S. Lee (ed.)

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Nuclear medicine is practiced every day in the clinic by nuclear physicians in collaboration with nuclear biologists, chemists, and physicists. Nanomedicine is a medical application of nanotechnology, and it uses nanomaterials, biologic and nanoelectronic devices, biosensors, and possibly molecular nanotechnology. One way nanomedicine has expanded is into radionanomedicine, which relies on the labeling of radionuclides onto a small amount of nanomaterials for theragnosis. This expansion might help to solve the problems in the current practice of medicine, which includes oncology, infection/inflammation, and brain and heart diseases. Scientists would like to understand how to coordinate and implement the current knowledge of nanomaterials and their behavior in the human body to further the use of theranostics. This is the first book describing the combined efforts of physicians and radiopharmaceutical scientists in creating a new medical field, radionanomedicine.

The book was written by 35 contributors who are the experts in nuclear medicine and nanotechnology. It is organized into 8 parts with 22 chapters. Part I, with 4 chapters, deals with exogenous radionanomedicine, including inorganic, graphene-based and organic nanomaterials, as well as porphyrin and phthalocyanine radiolabeling. The 4 chapters in part II discuss endogenous radionanomedicine, including extracellular vesicles, radiolabeling, biodistribution and imaging as well as validation of therapeutic potential. Part III, with 2 chapters, handles surface modification and radiolabeling, and part IV, with 3 chapters, reviews targeted delivery using click chemistry and  $^{18}\text{F}$  labeling. Part V (2 chapters) discusses in vivo biodistribution, including preclinical PET and SPECT as well as tracer kinetics, and part VI (3 chapters) deals with factors affecting biodistribution, including pharmacokinetics, polyethylene glycolation, excretion, and clearance. Part VII, with 2 chapters, discusses immune response and innate immunity to nanomaterials, and part VIII (2 chapters) provides prospects of molecular imaging and theranostics of radionanomedicine. There is a short summary in each part, which is educational. The illustrations are clear and informative, and tables are concise and helpful. References in each chapter are updated, and the index is useful.

The editor's purpose and vision of furthering the understanding of radionanomedicine is clearly met with this first book on the topic. I am sure that this book stimulates research workers in nanomedicine to improve nanotechnology and its application in medicine as nanomedicine affects almost all the aspects of health care. I highly recommend this book to all practitioners

as well as research workers in nuclear medicine, imaging, and nanotechnology.

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**Nuclear Medicine Board Review: Questions and Answers for Self-Assessment, Fourth Edition**

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This self-assessment question-and-answer review book provides a systematic review of key nuclear medicine concepts, with the intent of guiding trainees to pass the board examinations in nuclear medicine and radiology, as well as the specialty boards in nuclear radiology. Unlike traditional diagnostic radiology, nuclear medicine actively images physiologic and pathophysiologic processes to diagnose disease. Nuclear medicine has remained a highly specialized field with important applications, including the diagnosis, staging, and in some cases treatment of malignancy. The clinical relevance of this field results in a heightened importance of training a skilled, new generation of nuclear medicine physicians. The target audience for this book includes trainees with a strong knowledge base in the subject who are looking to test their understanding of key concepts and image interpretation. This book can be used for a concise review of all key facets of nuclear medicine before the board examination.

The first section, on essentials, is further subdivided into 4 chapters: radionuclides and radiopharmaceuticals, instrumentation, quality control, and radiation safety/legal requirements. Combined, this section reviews some key basic points in the physics of nuclear imaging, as well as some important safety concepts. The text pages are organized into side-by-side question-and-answer columns, with many of the questions in this section in a "fill-in-the-blank" format. Although some readers may not find this style particularly appealing, it is important to remember that this text is designed as a review source for those with a basic knowledge foundation, not as a primary learning source. The chapters on quality control and radiation safety/legal requirements include questions on high-yield, testable concepts for both nuclear medicine and diagnostic radiology trainees.

The next section of the book reviews single-photon applications, divided by organ system. The beginning of each chapter in this section includes relevant questions on basic radiotracer and physical

principles. The question variety includes multiple choice, true or false, and matching styles, which help to test the reader's knowledge in several different ways. The questions that require image interpretation are also quite helpful in preparing the reader not only for the board examination, but also for clinical practice. One could argue, however, that some of the provided clinical images are suboptimally sized, which makes interpretation difficult. Despite this, the key teaching concept from each question remains clear to the reader.

The third section pertains to PET/CT, a particularly critical branch of nuclear medicine in the modern era. PET plays a critical role in both the diagnosis and the staging of malignancy, and the fusion with CT allows for precise anatomic localization. This advancement in technology places increased responsibility on the nuclear medicine physician to integrate the patient's clinical history with accurate image interpretation, as oncologic therapy depends on staging. The questions in this section review the use of PET as it pertains to the most commonly evaluated cancers, including breast, lung, gastrointestinal, genitourinary lymphoma, and head/neck malignancies. By reviewing the questions in these sections, it should also become clear to the reader that it is important not to overdiagnose or misdiagnose malignant activity, as this may have serious treatment implications for the patient. For example, one question describes a patient with bilateral breast cancer and silicone prostheses. PET/CT images are provided, showing minimally avid internal mammary lymph nodes. Although it may be tempting to immediately conclude that these are metastatic, the question teaches the reader that these nodes may be reactive secondary to silicone breast prostheses, and thus can be followed with breast MRI.

The fourth and final section pertains to radionuclide therapy, which is the use of radiopharmaceuticals to cure or control malignant disease. The questions in this section cover the recommended therapies and doses for commonly treated cancers, as well as appropriate safety precautions. The continuing evolution of radionuclide therapy will keep the nuclear medicine physician at the forefront of oncologic treatment as part of a multidisciplinary team. For example, several questions pertain to the use of  $^{90}\text{Y}$  for the treatment of hepatic malignancy, a

therapy delivered by interventional radiologists. In this clinical scenario,  $^{90}\text{Y}$  spheres are delivered by direct injection into the hepatic artery. One question reviews several purposes of the pretreatment planning phase angiogram and macroaggregated albumin scan. These include documenting tumor blush; verifying no evidence of abnormal visceral distribution or coil embolization of adjacent arterial branches; and evaluating for lung shunting. Here, the nuclear medicine physician must work together as part of the interdisciplinary team to calculate the accurate dosage and interpret pre- and posttreatment imaging.

*Nuclear Medicine Board Review* is a well-written book that provides a concise self-assessment of nearly all major categories of nuclear medicine. Because of the small size of the book there are some expected limitations. For example, there are no explanations to most of the answers, which would help to clarify certain points and reinforce key concepts. Many questions do not have answer choices, and in some instances, it is sometimes difficult to predict the answer the author is looking for. Despite these shortcomings, it is important to remember that this book is meant for physicians nearing the end of their training and who should already have a good foundation in the subject. With this in mind, this review book is a good supplemental resource for trainees preparing for the board examinations.

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