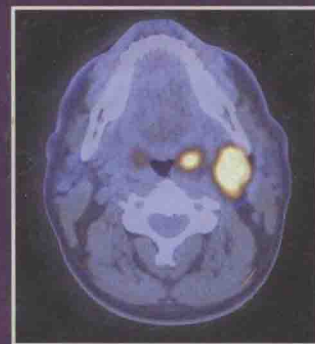
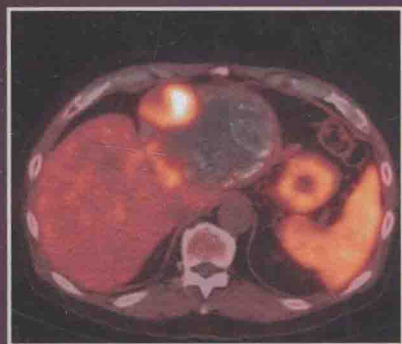


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Nuclear Oncology



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Stanley J. Goldsmith

Foreword by Heinrich R. Schelbert

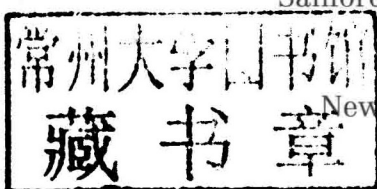
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To my wife, Miriam Goldsmith, who dedicated her life to our family, to my professional goals, and to me. Her love made possible the life that I have been fortunate enough to have lived.

Stanley J. Goldsmith, MD

To Mustafa Kemal Ataturk, the founder of Republic of Turkey, who established the foundations of modern scientific education in my country.

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FOREWORD

Nuclear Medicine has grown at an astonishing pace. When I first became involved in Nuclear Medicine, imaging had just transitioned from rectilinear scanners to gamma cameras; planar imaging of the brain, of perfusion and ventilation of the lung, of colloid uptake in the liver and spleen, of gall bladder function and renal blood flow and function dominated the daily nuclear medicine fare. Imaging of the cardiovascular system was in its infancy and nuclear oncology consisted bone imaging and an occasional gallium uptake study.

The introduction of cross-sectional imaging with computed tomography (CT) and later with magnetic resonance imaging (MRI) profoundly transformed the field of diagnostic imaging. In fact, the arrival of CT was feared to threaten the very existence of nuclear medicine; radionuclide procedures like the many brain scans soon began to disappear from the daily nuclear medicine schedule as CT became clinically available.

Yet, nuclear medicine has proved itself to be astoundingly resilient. With single photon emission tomography (SPECT) and positron emission tomography (PET), nuclear medicine joined cross-sectional imaging, yet in a unique and specific way by focusing on assays of tissue function and biology rather than on anatomy. Combined with anatomic imaging with PET/CT or PET/MRI today, molecular and cellular events visualized on radionuclide images can now be localized precisely. Even more importantly, as these images display biologic properties of anatomic alterations, hybrid function/structure imaging has gained growing clinical interest and importance. Accordingly, nuclear medicine schedules have dramatically changed. Today, they are dominated by qualitative and quantitative image-based tissue assays with SPECT/CT and especially PET/CT for cancer diagnosis and staging, prediction of clinical outcomes, and monitoring therapy responses, for planning radiation therapy and for identifying treatment targets.

Nuclear medicine owes much of this change to impressive advances in cancer research which have led to an improved and more detailed understanding of cancer biology, including tumor growth and angiogenesis, growth receptor function and intracellular signaling chains, and cancer survival strategies. They have also defined key regulatory steps as potential treatment targets. These advances have driven the development of highly targeted imaging probes for the noninvasive visualization of molecular and cellular events ranging from substrate utilization to amino acid metabolism and cell growth, angiogenesis and perfusion as well as cell membrane receptors regulating cell growth and replication. Labeled with radionuclides, many of these targeted imaging probes, tested and validated in the research laboratory, are now entering the clinical environment. They arm both, the nuclear medicine physician and the oncologist with specific tools for the image-based detection of cancer, estimation of its severity and extent, prediction of tumor progression and outcome and, importantly, measurements of therapy responses. With these tools, the nuclear medicine physician participated as "nuclear oncologist" in the care of cancer patients.

With this book, Drs. Cumali Aktolun and Stanley J. Goldsmith, well-known authorities in nuclear medicine, have enlisted many internationally known specialists to present, for the first time, a much needed comprehensive account of today's nuclear oncology. This "inventory" of today's nuclear oncology appropriately proceeds with a series of reviews of organ-related malignancies and of system-wide cancers, to practical issues in cancer imaging and, finally, to image-based assays of cancer biology and radionuclide therapy. Each chapter on organ-related or system-wide tumors presents the current knowledge of molecular cancer pathogenesis and development, early tumor manifestations and tumor spread, established and emerging therapeutic strategies and clinical outcomes. Advantages and limitations of diagnostic approaches are critically assessed, including biomarkers and image-based technologies for cancer diagnosis and staging, for cancer recurrence and therapy response. Nuclear medicine approaches like planar and SPECT imaging are included but applications of modern PET/CT imaging are emphasized appropriately. Their utility is fully integrated with that of more conventional imaging technologies like ultrasound, CT, and MRI for optimizing the diagnostic approach to cancer diagnosis and characterization. Importantly, the "inventory of nuclear oncology" extends into more specific topics like cancer in the pediatric population, image-based monitoring of treatment responses but also of chemotherapy-related adverse effects, to image-based target identification and targeted radionuclide therapeutic strategies ("theranostics") and the role of nuclear medicine in response-adapted treatment strategies. Each topic is abundantly illustrated with high quality mostly color renditions of cancer-specific findings made with CT, MR, SPECT, and PET/CT. Beyond these diagnostic radionuclide approaches largely implemented in today's clinical practice, the "nuclear oncology inventory" ventures into emerging approaches and thus offers a view of what may lie ahead. This prospect of the future includes radionuclide technologies employed primarily in the research environment but attests to future clinical possibilities for targeting specific aspects of molecular cancer biology such as for example growth receptors, hypoxia, cell replication, angiogenesis, extracellular matrix formation, and apoptosis.

The text succeeds in merging basic and clinical sciences in oncology with knowledge in nuclear imaging and therapy. As such, it is of considerable interest to both, the clinician and the imager. Importantly, it is destined to intensify and broaden interactions and collaborations between nuclear and clinical oncologists.

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