Clinical Scintillation Imaging

Second Edition

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TO OUR WIVES
MARLENE AND CAROL
AND TO OUR FAMILIES

Preface to the First Edition

In the last fifteen years organ imaging by scintillation scanning has grown into a vigorous discipline whose impact is felt in most branches of medicine. The functional and morphologic data uniquely provided by scanning contribute not only to improved diagnosis and management, but also to our knowledge and understanding of disease in man. Clinically effective and without significant morbidity, scanning procedures impart a radiation burden no greater (and usually less) than that of diagnostic roentgenology.

The purpose of this text is to consolidate our present knowledge of scintillation scanning into a single-volume reference for the physician. We have sought to meet this aim by critically describing current scanning techniques, their indications, information yield, limitations, and future promise. Since it is no longer possible for one individual to have equal expertise in all aspects of scanning, we have asked recognized authorities in various fundamental and clinical areas of scintillation scanning to contribute chapters on their special fields. We are grateful to our colleagues for these contributions.

In a proliferating field such as nuclear medicine, any text becomes outdated quickly. Had this book been written even a short time ago, much of its present content could not have been included. By the same token certain procedures discussed in these pages are not yet authorized for routine clinical use despite their unquestioned clinical value. We hope that current restrictions on placental blood pool scanning and bone scanning, for example, will be removed since alternate methods are less informative, deliver a greater radiation burden, or both.

The pace at which new developments continue to appear reflects the impetus behind scintillation scanning provided by the clinical investigator, the physiologist, the radiochemist, the physicist, and the instrument designer. The purpose underlying their efforts is to improve the quality of medical care through the peaceful applications of atomic energy. Scintillation imaging will continue to make valuable contributions toward this end.

New York City, 1969

Leonard M. Freeman
Philip M. Johnson

Preface to the Second Edition

The remarkable impact of scintillation imaging in clinical practice is the primary reason for the recognition of nuclear medicine as the newest medical specialty and for the requirement that every accredited hospital in the United States provide nuclear medical services.

The principal reason for the growth and utilization of scintillation imaging lies in its efficacy. Examinations of high quality, supervised and interpreted by the trained nuclear medicine specialist, yield valuable information in the diagnosis and management of a variety of disorders. Nearly all imaging procedures are noninvasive, simple, and without morbidity. The safety of intravenously administered tracers rests on secure grounds, for vast numbers of administrations have been performed with only rare reports of complications. The absorbed radiation dose inherent in these procedures is lower than that of most comparable radiographic studies.

The number of clinical settings in which radionuclide imaging is pertinent continues to increase, most recently with the discovery that labeled phosphate compounds localize in the acutely infarcted myocardium. Concurrent progress has led to refinement of older imaging techniques. In 1975 a radionuclide study of the kidney can provide not only morphologic data but also information concerning absolute and relative perfusion by renal arterial blood and urine formation and flow. The diagnosis of pulmonary embolism as a possible cause of regional pulmonary ischemia becomes established if normal ventilation is demonstrated.

In the course of this growth, certain older diagnostic techniques have been displaced. Arteriography is seldom performed today in suspected pulmonary embolism, and radionuclide bone imaging is steadily replacing the radiographic skeletal survey as a screening test. Similarly, some radionuclide studies have been challenged by newer modalities. For example, placental blood-pool imaging is being replaced by B-mode ultrasonography. The potential effect of computerized tomographic scanning of the brain is a source of

current investigation in many institutions, and its impact on static brain imaging will likely be significant.

The advances in scintillation imaging have resulted from the efforts of physicians, physicists, physiologists, chemists, engineers, and other specialists based in universities, research institutes, and the national laboratories of this and other nations. With varying degrees of alacrity, private industry has made them available to the medical community. This evolutionary process, nurtured here by the U.S. Atomic Energy Commission, has taken place in spite of progressively stringent governmental controls. Today nuclear medicine is subject to a degree of regulation unknown in other medical specialties. Yet its contribution to the population radiation burden is exceedingly small. Thus the estimates by the National Academy of Science of the annual whole-body absorbed dose rates in the United States for the year 1970 were for diagnostic radiology 72 mrem, for radiopharmaceuticals 1 mrem. We note that the term radiopharmaceuticals includes radioactive agents given in millicurie doses for therapeutic effect. It is inappropriate to categorize radioactive diagnostic tracers as radiopharmaceuticals, since they possess no therapeutic or physiological action. Overzealous regulation carries the real threat of stifling future progress.

Proper clinical application of imaging techniques must adhere to the principle that the anticipated good outweighs potential harm. The question to be asked before undertaking a procedure is whether the results, positive or negative, will alter the patient's diagnosis or treatment. It is well to bear in mind a paraphrase of Lord Cohen's aphorism: The feasibility of a procedure is not the *best* indication for its performance. The nuclear medicine physician is well qualified to make this assessment, given full awareness of the clinical setting and the problem at hand. This is the individual who has final responsibility for the decision.

The second edition of this text has been renamed and extensively rewritten. Major updatings were necessary to encompass the advances of the last 6 years. A new chapter discusses some of the problems associated with the growing area of rapid dynamic imaging and data processing. We extend our thanks to our colleagues who have contributed to this text. Its purpose remains that of consolidating current clinical knowledge of scintillation imaging into a complete single-volume reference for the physician who practices this challenging discipline and for those who would follow.

New York City, 1975

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Fundamental Considerations