Diagnostic Nuclear Medicine: A Physics Perspective

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Diagnostic Nuclear Medicine: A Physics Perspective, a textbook for medical physicists, physicians, and technologists who are studying or practicing nuclear medicine, comprises 25 chapters divided into 4 main parts: radiation, detection systems, clinical procedures, and quality assurance (QA) and includes 145 figures and 34 tables. The author, David Hamilton, wrote all the chapters except 2, which were contributed by Peter J. Riley. Both individuals are with the Riyadh Al Kharj Hospital Programme in Saudi Arabia.

Part 1, on radiation, comprises 5 chapters covering radioactivity, radiopharmaceuticals, the biologic effects of radiation, protection of the community, and protection of the patient. The primary objective of this part is to describe the characteristics of radioactivity, the modes of radioactive decay, the requirements for an ideal nuclear medicine radiopharmaceutical, the risks of using radioactive material, and techniques to protect the environment and the patient.

Part 2, on detection systems, comprises 7 chapters. The first covers radiation detectors and measurement statistics; the second, nonimaging systems such as probes, counters, and monitoring devices. Chapters 3–5 cover planar, SPECT, and PET systems, and chapters 6 and 7 cover image presentation and computers and communications. The chapters on imaging systems are well organized and discuss topics such as scanner designs and configurations, performance characteristics, modes of data acquisition, reconstruction techniques, correction techniques, and descriptors and factors affecting image quality. Chapters 6 and 7 primarily introduce the reader to computers and data networking.

Part 3, on clinical procedures in routine diagnostic nuclear medicine, is organized similarly to part 2 and comprises 5 chapters. Chapter 1 is on nonimaging studies, with a focus on in vitro and probe measurements. Examples of in vitro studies covered in this chapter include effective renal plasma flow, glomerular filtration rate, vitamin B12 absorption, gastrointestinal iron absorption and protein loss, red blood cell survival, and breath and dilution analyses. Probe studies, on the other hand, are divided into surface counting such as red blood cell sequestration and thyroid uptake and intraoperative counting such as sentinel lymph node identification. Chapters 2–4 describe the use of planar, SPECT, and PET scanners in routine clinical nuclear medicine procedures. All 3 chapters are organized similarly. Each discusses the effects of the acquisition parameters specific to each imaging device, describes the processing considerations, and reviews the technical aspects of various clinical protocols associated with each imaging modality. For example, the chapter on SPECT starts with a description of the acquisition parameters that affect image quality, such as collimator type, pixel size, count density, detector orientation, rotation orbit, rotation arc, acquisition mode, number of projections, energy window, and patient position. Considerations in SPECT image processing are then introduced, such as reconstruction algorithms and filter parameters, resultant slice thickness, partial-volume effects, attenuation correction, and scatter rejection techniques. Finally, technical considerations in clinical protocols for the abdomen, bone, spine, breast, heart, and thorax are introduced. The last chapter in this part of the book introduces the reader to image processing and analysis. The basics of transfer functions, window levels, image histograms, arithmetic curve fitting, and data smoothing are covered.

Part 4, on QA, comprises 8 chapters, including an introductory chapter on the meaning and value of QA procedures, 4 chapters on imaging and nonimaging systems, and 3 chapters on QA procedures for radiopharmaceuticals, computers, and image presentation systems. All the chapters present operational and routine tests for the device or product under consideration. In the case of imaging systems, additional QA tests are presented. For example, the chapter on planar imaging describes tests of intrinsic and extrinsic system performance, and the chapters on SPECT and PET describe acceptance-testing measurements.

The book concludes with a useful, 5-section appendix. Sections 1 and 2 provide tables of unit conversions and decay characteristics of radionuclides commonly used in nuclear medicine. Section 3 focuses on the designs of various collimators and their impact on scanner performance, and section 4 presents various models to calculate glomerular filtration rate based on single samples. Finally, section 5 presents a table of typical acquisition and processing parameters used in single photon imaging protocols. I found this table useful as a quick reference, particularly because it referenced most of the listed protocols.

In summary, I found the book to be well organized and up to date. Each chapter started with a detailed table of contents followed by a list of the abbreviations used in the chapter.

A comprehensive, alphabetic list of references ended each chapter. I have 3 main criticisms of this book. The first is a lack of examples of the material discussed. The second is an inadequate use of figures. Although the book contained 145 figures, none showed an actual clinical PET, SPECT, or planar scan and most were based on diagrams. Finally, the book did not include a section on imaging artifacts in nuclear medicine. Having said that, I still believe this book is an adequate reference for students, medical physicists, physicians, and technologists who are studying or practicing nuclear medicine.

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