Positron Emission Tomography

Peter E. Valk, Dominique Delbeke, Dale L. Bailey,
David W. Townsend, and Michael N. Maisey *(Eds)*

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Clinical Practice

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Peter E. Valk, MB, BS, FRACP
Northern California PET Imaging Center
Sacramento, CA, USA

Dominique Delbeke, MD, PhD
Professor and Director of Nuclear Medicine
Positron Emission Tomography
Department of Radiology and Radiological Sciences
Vanderbilt University Medical Center
Nashville, TN, USA

Dale L. Bailey, PhD
Associate Professor of Medicine
Department of Nuclear Medicine
Royal North Shore Hospital
Sydney, Australia

David W. Townsend, PhD
Director
Cancer Imaging and Tracer Development Program
The University of Tennessee Medical Center
Knoxville, TN, USA

Michael N. Maisey, BSc, MD, FRCR, FRCP
Professor of Emeritus
Department of Radiological Sciences
Guy's and St Thomas' Clinical PET Centre
Guy's and St Thomas' Hospital Trust
London, UK

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Foreword

The use of positron emission tomography (PET) in clinical practice is key to the successful management of many patients with a wide variety of diseases. Whereas in the 1980s and 1990s nuclear medicine physicians struggled to convince other doctors about the potential clinical value of PET, it is now a challenge to keep up with the requests of our clinical colleagues for the various applications of PET. In fact, in most cases the barriers are now related to reimbursement for a given PET procedure. At the time this foreword was written, many FDG/PET procedures are reimbursable, and the U.S. National PET Registry, which is about to be implemented, will allow FDG/PET imaging data to accumulate on rare tumors, while allowing for Center for Medicare and Medicaid Services (CMS) reimbursement. The challenges are now shifting toward solving some of the limitations of FDG/PET through the use of next generation instrumentation and newer tracers that hold the promise of improving on what is already a remarkable achievement with FDG/PET.

It is my hope that there will in fact be an enormous growth of nuclear medicine driven by new imaging tracers that will fuel a growing number of clinical applications. Many failures will occur in order to give rise to the next generation of PET imaging tracers, but these failures are be necessary on the road to a better tomorrow. Perhaps a "Super FDG" will be born out of these efforts, along with very specific imaging tracers useful for very select groups of patients. Technology will continue to drive our ability to identify new cellular targets, new molecular imaging agents against those targets, and the routine high-throughput synthesis and use of those new imaging tracers. Just as PET/CT has markedly influenced the growth of FDG/PET, newer technologies will likely come into play. The debut of MR-PET, molecular imaging technologies such as molecular optical imaging, and many other technologies will likely change the landscape of nuclear medicine forever. To keep the correct perspective we must remember that it is not about the technologies per se, but really about optimal patient care. We must not slip into the future, but plan for the future so we maximize our ability to help patients through the power of nuclear medicine and molecular imaging. However technologies and new tracers evolve, the concepts of interrogation at the cellular and molecular level will continue to define the evolution of nuclear medicine and the interception of disease processes through functional imaging.

The use of PET and PET/CT in patient care is best learned from clinicians at the leading edge of imaging who also routinely interpret the images. This excellent book put together by leading clinicians, who have helped the field of PET to get to the current stage, is an enormous educational resource. It is very thorough with clear examples and covers all major aspects of PET/CT application in patient management. Someday, technologies will surely evolve so that authors will be seen and speak to us virtually and interactively through "digital books." For now we must be content to learn from the best teachers through their words and image examples on paper. This book is the next best thing to having all the contributing authors virtually teaching the student about all aspects of PET/CT. Till the day that digital interactive books arrive, I plan on keeping this book nearby.

Sanjiv Sam Gambhir MD, PhD
Stanford University

Preface

Peter E. Valk passed away on December 16, 2003 in Berkeley, California. David Townsend wrote in the "*In Memoriam*" that was published in the February 2004 issue of the *Journal of Nuclear Medicine*: "He will be deeply missed by his many friends and colleagues throughout the Nuclear Medicine and PET community world-wide for his insight, knowledge, integrity and humour."

Peter was a dear friend and we certainly miss him. In 2003, Peter coedited *Positron Emission Tomography: Basic Science and Clinical Practice,* a comprehensive contemporary reference textbook on positron emission tomography (PET). A few months before he died, Peter informed me that Springer intended to divide this nearly 900 pages textbook into two separate volumes for clinical and basic sciences. Peter was acutely aware of his prognosis and asked me if I would be willing to take over and edit the clinical volume. I willingly accepted. This book *Positron Emission Tomography: Clinical Practice* is a selected and updated version of the clinical chapters from the original book.

Positron Emission Tomography is an exceptional functional imaging tool. There has been a tremendous increase in interest in PET in the past decade, not only as a research tool but particularly in the clinical arena. The editors of the original book (Peter Valk, Dale Bailey, David Townsend and Michael Maisey) noted how they had collectively been involved in many aspects of PET development, including instrumentation, algorithms and protocol developments and applications, as well as the training of basic scientists and medical specialists, and efforts to convince health bureaucrats of the value of functional imaging in patient management. Through their extensive involvement in all aspects of PET, they progressively became aware of the lack of a comprehensive and contemporary reference work covering the science and clinical applications of PET. The original edition of their book arose from a desire to redress this situation.

The field of PET is progressing rapidly with the developments of multimodality imaging using integrated PET/CT systems. For this separate edition of clinical applications, the intent remains true to the aims of the first edition, namely, to provide a contemporary reference work covering the science and clinical applications of PET with extensive updating to include PET/CT technology. The book is designed to be used by residents and fellows training in medical imaging specialties as well as imaging experts in private or academic medicine who need to become familiar with this technology, and by those whose specialties carry over to PET and PET/CT such as oncologists, cardiologists, neurologists and surgeons.

Chapters 1 to 4 address the basic aspects of PET and PET/CT including physics and instrumentation, an overview of the clinical advantages of the PET/CT technology over PET or CT alone; the viewpoint of the technologist, radiation dosimetry and protection. Chapters 5 to 25 address oncologic applications and have been significantly updated with new data related to the PET/CT technology; many PET/CT illustrations are included. As in the first edition, a chapter is devoted to infectious diseases and another to PET imaging in pediatric disorders. Chapter 26 is an overview of the cardiac applications of PET, and Chapter 27 discusses cardiac PET/CT that some experts envision as the future one-stop-shop cardiac examination. Chapter 28 is an overview of PET imaging in clinical neurology and is probably the least influenced by recent development of PET/CT technology.

To conclude, I restate part of the preface from the first edition:

We are indebted to the many friends and colleagues who have contributed to this book, and who have willingly shared their knowledge and experience.

The functional nature of PET is based on its ability to target specific biochemical pathways through sophisticated radioactive probes and to record the time course of tracer uptake with highly sensitive instrumentation. PET is indeed a rich area in which to work, in part because of the multidisciplinary nature of the field. Developments in instrumentation, for example, are as much driven by radiochemistry and medical challenges as they are by progress in basic physics and instrumentation. Manufacturers of PET instrumentation have also played a major role in the development of the field by sharing many of their designs for critical appraisal at an early stage, and by being willing to listen to, support, and often fund novel prototype concepts. The development of the combined PET/CT scanner is a prime example of this collaboration.

PET is currently moving forward rapidly on a number of fronts: instrumentation is developing at a fast pace; synthetic radiochemistry is becoming more sophisticated and reliable; new reconstruction algorithms and processing methods are becoming more generally usable because of rapid advances in computer hardware and software; clinical applications are burgeoning as PET becomes affordable for more practitioners; and developments in molecular biology and functional genomics provide opportunities for monitoring gene expression and targets for gene therapy.

In this context, it is a challenge to produce a reference work which remains current even during the period from production of the original text to eventual publication, let alone for a significant number of years afterwards. We leave it up to the reader, and to future readers, to assess how successful we have been in this endeavour.

Dominique Delbeke, MD, PhD
December 2005

Contents

Contributors

Abass Alavi, MD
Department of Radiology
Division of Nuclear Medicine
Hospital of the University of Pennsylvania
Philadelphia, PA, USA

Elias J. Anaissie, MD
Myeloma Institute for Research and Therapy
University of Arkansas for Medical Sciences
Little Rock, AR, USA

Edgardo J.C. Angtuaco, MD
Section of Neuroradiology
Department of Radiology
University of Arkansas for Medical Sciences
Little Rock, AR, USA

Dale L. Bailey, PhD
Associate Professor of Medicine
Department of Nuclear Medicine
Royal North Shore Hospital
Sydney, Australia

Bart Barlogie, MD, PhD
Myeloma Institute for Research and Therapy
University of Arkansas for Medical Sciences
Little Rock, AR, USA

Frank M. Bengel, MD
Nuklearmedizinische Klinik
Technische Universität München
München, Germany

Trond V. Bogsrud, MD
Department of Medical Imaging
Division of Nuclear Medicine
University Clinic
The Norwegian Radium Hospital
Oslo, Norway

Thierry Bury, MD, PhD
Division of Pulmonary Medicine
Department of Medicine
University Hospital of Liège, Sart-Tilman
Liège, Belgium

R. Edward Coleman, MD
Department of Radiology
Division of Nuclear Medicine
Duke University Medical Center
Durham, NC, USA

Leonard P. Connolly, MD
Department of Radiology
Division of Nuclear Medicine
Children's Hospital
Boston, MA, USA

Gary J.R. Cook, MBBS, MSc, MD, FRCP, FRCR
Department of Nuclear Medicine and PET
Royal Marsden Hospital
Sutton, UK

Bernadette F. Cronin, DCR (R), DRI, FETC
Department of Nuclear Medicine and PET
The Royal Marsden Hospital
Sutton, UK

Farrokh Dehdashti, MD
Division of Nuclear Medicine
Edward Mallinckrodt Institute of Radiology
Washington University School of Medicine
St. Louis, MO, USA

Dominique Delbeke, MD, PhD
Professor and Director of Nuclear Medicine
Positron Emission Tomography
Department of Radiology and Radiological Sciences
Vanderbilt University Medical Center
Nashville, TN, USA

Marcelo F. Di Carli, MD
Department of Radiology
Division of Nuclear Medicine/PET
Brigham and Women's Hospital
Harvard Medical School
Boston, MA, USA

Stefan Eberl, BE, MSc, PhD
Department of PET & Nuclear Medicine
Royal Prince Alfred Hospital
Sydney, Australia

Joshua Epstein, DSc
Myeloma Institute for Research and Therapy
University of Arkansas for Medical Sciences
Little Rock, AR, USA

Frederic H. Fahey, DSc
Department of Radiology
Division of Nuclear Medicine
Children's Hospital
Boston, MA, USA

Ignac Fogelman, MD, FRCP
Department of Nuclear Medicine
Guy's and St Thomas' Hospital
Guy's and St Thomas' Hospital Trust
London, UK

Sharon F. Hain, BSc, MBBS, FRACP
Institute of Nuclear Medicine
Middlesex Hospital
UCH NHS Trust and Hammersmith Hospitals NHS Trust
London, UK

Roland Hustinx, MD
Division of Nuclear Medicine
Department of Medicine
University Hospital of Liège, Sart-Tilman
Liège, Belgium

Ora Israel, MD
Department of Nuclear Medicine
Rambam Medical Center
Haifa, Israel

Hossein Jadvar, MD, PhD, FACNM
Department of Radiology
Division of Nuclear Medicine
Keck School of Medicine
University of Southern California
Los Angeles, CA, USA

Guy H.M. Jerusalem, MD, PhD
Division of Medical Oncology
Department of Medicine
University Hospital of Liège, Sart-Tilman
Liège, Belgium

Laurie B. Jones-Jackson, MD
Department of Radiology
University of Arkansas for Medical Sciences
Little Rock, AR, USA

Lale Kostakoglu, MD
Department of Radiology
Division of Nuclear Medicine
The New York Presbyterian Hospital
Weill Medical College of Cornell University
Weill Cornell Medical Center
New York, NY, USA

Kenneth A. Krohn, PhD
Departments of Radiology and Radiation Oncology
University of Washington
Seattle, WA, USA

Val J. Lowe, MD
Department of Radiology
Division of Nuclear Medicine
Mayo Clinic
Rochester, MN, USA

Michael N. Maisey, BSc, MD, FRCR, FRCP
Professor of Emeritus
Department of Radiological Sciences
Guy's and St Thomas' Clinical PET Centre
Guy's and St Thomas' Hospital Trust
London, UK

William H. Martin, MD
Department of Radiology and Radiological Sciences
Vanderbilt University Medical Center
Nashville, TN, USA

I. Ross McDougall, MBChB, MD, PhD, FRCP
Division of Nuclear Medicine
Stanford University Medical Center
Stanford, CA, USA

Marisa Miceli, MD
Myeloma Institute for Research and Therapy
University of Arkansas for Medical Sciences
Little Rock, AR, USA

Michael J. O'Doherty, MA, MSc, MD, FRCP
Department of Nuclear Medicine
Clinical PET Centre
Guy's, King's and St Thomas' School of Medicine
Guys and St Thomas' NHS Trust
St Thomas' Hospital
London, UK

Paola Piccini, MD, PhD
Division of Neurosciences and Mental Health
Imperial College School of Medicine
Hammersmith Hospital
London, UK

Joseph G. Rajendran, MD
Division of Nuclear Medicine
University of Washington Medical Center
Seattle, WA, USA

Erik Rasmussen, MS
Cancer Research and Biostatistics
Seattle, WA, USA

Pierre Rigo, MD, PhD
Department of Nuclear Medicine
Centre Hospitalier Princesse Grace
Monaco

Christiaan Schiepers, MD, PhD
Molecular and Medical Pharmacology
David Geffen School of Medicine at UCLA
Los Angeles, CA, USA

Markus Schwaiger, MD
Nuklearmedizinische Klinik
Technische Universität München
München, Germany

George M. Segall, MD
Nuclear Medicine Services
Veterans Affairs Palo Alto Health Care System, Palo Alto CA, and
Department of Radiology
Stanford University School of Medicine
Stanford, CA, USA

Anthony F. Shields, MD, PhD
Department of Internal Medicine
Karmanos Cancer Institute
Wayne State University
Detroit, MI, USA

Paul D. Shreve, MD
Advanced Radiology Services PC
Grand Rapids, MI, USA

Barry L. Shulkin, MD, MBA
Division of Diagnostic Imaging
St. Jude's Children's Research Hospital
Memphis, TN, and
Division of Nuclear Medicine
Department of Radiology
University of Michigan Medical Center
Ann Arbor, MI, USA

Barry A. Siegel, MD
Division of Nuclear Medicine
Edward Mallinckrodt Institute of Radiology
Washington University School of Medicine
St. Louis, MO, USA

Michael A. Smith, MA, MB BChir, FRCS
Department of Orthopaedics
The St Thomas' Soft Tissue Tumor Unit
Guys and St Thomas' NHS Trust
Guy's Hospital
London, UK

Brendan C. Stack, Jr., MD, FACS
Division of Otolaryngology, Head and Neck Surgery
Pennsylvania State University College of Medicine and Milton S. Hershey Medical Center
Hershey, PA, USA

Susan M. Swetter, MD
Dermatology Services
Veterans Affairs Palo Alto Health Care System, Palo Alto CA, and
Department of Dermatology
Stanford University School of Medicine
Stanford, CA, USA

Yen F. Tai, MB BS, MRCP
Division of Neurosciences and Mental Health
Imperial College School of Medicine
Hammersmith Hospital
London, UK

David W. Townsend, PhD
Director
Cancer Imaging and Tracer Development Program
The University of Tennessee Medical Center
Knoxville, TN, USA

Jocelyn E.C. Towson, MA, MSc
Department of PET & Nuclear Medicine
Royal Prince Alfred Hospital
Sydney, Australia

Guido J. Tricot, MD, PhD
University of Arkansas for Medical Sciences
Myeloma Institute for Research and Therapy
Little Rock, AR, USA

†Peter E. Valk, MB, BS, FRACP
Northern California PET Imaging Center
Sacramento, CA, USA

Frits Van Rhee, MD, PhD
Myeloma Institute for Research and Therapy
University of Arkansas for Medical Sciences
Little Rock, AR, USA

Richard L. Wahl, MD
The Johns Hopkins PET Center
Russell H. Morgan Department of Radiology and Radiological Science
Johns Hopkins University (JHU) School of Medicine
Baltimore, MD, USA

Ronald C. Walker, MD
Department of Radiology
University of Arkansas for Medical Sciences
Little Rock, AR, USA

Terence Z. Wong, MD, PhD
Department of Radiology
Division of Nuclear Medicine
Duke University Medical Center
Durham, NC, USA

Hongming Zhuang, MD, PHD
Department of Radiology
Division of Nuclear Medicine
Hospital of the University of Pennsylvania
Philadelphia, PA, USA

† Deceased.

Positron Emission Tomography (PET) - Learn about the causes, symptoms, diagnosis & treatment from the MSD Manuals - Medical Consumer Version.Â Positron emission tomography (PET) is a type of radionuclide scanning. A radionuclide is a radioactive form of an element, which means it is an unstable atom that becomes more stable by releasing energy as radiation. Most radionuclides release high-energy photons as gamma rays but PET uses radionuclides that release particles called positrons. This post aims to explain what positron emission tomography (PET) is and how it works. PET is a unique type of medical imaging that reveals information about the physiology of organs and tissues, unlike CT or MRI machines which only yield images of anatomy. By doing this, PET scans can often detect irregularities such as cancer significantly earlier than other diagnostic tests. The scan works by injecting a radioactive tracer into the A positron emission tomography (PET) scan is an imaging test that helps reveal how your tissues and organs are functioning. A PET scan uses a radioactive drug (tracer) to show this activity. This scan can sometimes detect disease before it shows up on other imaging tests. Previous (Positivism (philosophy)). Next (Possum). Positron emission tomography (PET) is a nuclear medicine imaging technique that produces a three-dimensional image or map of functional processes in the body. The system detects pairs of gamma rays emitted indirectly by a positron-emitting radionuclide (tracer), which is introduced into the body on a biologically active molecule. Images of tracer concentration in 3-dimensional space within the body are then reconstructed by computer analysis. In Positron Emission Tomography (PET). What is a cardiac PET scan? A PET scan of the heart is a noninvasive nuclear imaging test.Â Positron Emission Tomography (PET). Magnetic Resonance Imaging (MRI). Single Photon Emission Computed Tomography (SPECT). Exercise Stress Test. Holter Monitor.