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Image-Guided Cancer Therapy

A Multidisciplinary Approach

Springer Reference

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Editors

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With 394 Figures and 71 Tables

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ISBN 978-1-4419-0750-9 ISBN 978-1-4419-0751-6 (eBook)
ISBN 978-1-4419-0752-3 (print and electronic bundle)
DOI 10.1007/978-1-4419-0751-6
Springer New York Heidelberg Dordrecht London

Library of Congress Control Number: 2013937941

Printed on acid-free paper

Springer is part of Springer Science+Business Media (www.springer.com)

Image-Guided Cancer Therapy

We all have known several people who over the years motivate and drive us to continue our work in alleviating the pain and suffering of those with cancer. One of my former co-workers and good friend, Paul R. Morrison, was one of those.

Paul was a medical physicist in the Department of Radiology at Brigham & Women's Hospital. He received his M.Sc. in Physics from Illinois Institute of Technology in 1987. On graduating, he worked as a laser specialist in the Department of Dermatology at Boston University Medical Center. Thereafter, he moved across town and began work in the Department of Surgery at BWH, focusing on laser applications in otolaryngology. This quickly evolved into a series of clinical projects involving image-guided surgery as well as experiments in MRI of thermal events in tissue at the genesis of a growing collaboration between Surgery and Radiology. This collaboration evolved into what is now the Image Guided Therapy Program headed by Dr. Ferenc Jolesz. In 2000, he moved over to the Department of Radiology, with primary duties in the Cross-sectional Interventional Radiology Service and the Tumor Ablation Program. He is focused on image-guided thermal ablation (e.g., cryotherapy, radiofrequency, and laser) from both a clinical and experimental perspective. Over the years, he has been involved in hundreds of clinical procedures.

Paul is a member of the American Association of Physicists in Medicine. He has co-authored over 35 original articles on a range of related topics that include cryotherapy, radiofrequency ablation, laser, image-guided surgery, computer-assisted visualization, and computer-assisted

navigation in a range of organs and systems. In addition to a number of reviews and posters, he has been involved with over 50 scientific abstracts and has given presentations in a variety of academic and professional venues.

Paul was one of those rare individuals who emulates the highest qualities of a medical professional in the attitude in which he carried himself with his colleagues and patients. I always enjoyed his dry sense of humor and intellectual comments based on his unique viewpoint. He was one of the most intelligent people I have ever worked with. Paul lost his courageous battle with cancer on September 24, 2012. In addition to his vital role at BWH, he was a warm, thoughtful, and sensitive colleague and friend who will be deeply missed.

—William N. McMullen

Foreword

This book which has the "who's who" in interventional oncology as its editors, and, importantly, as its authors, incorporate a unique style and a completely integrated approach to this relatively new and fascinating field. Interventional oncology has literally rocketed to the forefront of interventional radiology, surgical oncology, radiation therapy, and oncology. There is not one meeting, nationally or internationally, in any of these specialties that does not address this subject.

What makes a book like this good? It's a combination of the editors and the authors. This is not just a book put together without thought with authors who are only slightly familiar with a topic. Indeed, the editors represent leaders in the field of interventional oncology and individuals who put this subspecialty on the map. They have carefully chosen outstanding leaders in the field to thoroughly address this new specialty. The reader will be exposed to all aspects of the specialty from interventional radiology to radiation therapy.

Led by Damian E. Dupuy, this group of editors have corralled this sometimes difficult and complicated subject into digestible bits that will allow interested physicians to understand and use them when needed. The book is organized topically, allowing the reader to become educated in all aspects of interventional oncology. Current areas of interest such as liver tumors, bone tumors, metastatic tumors, etc. allows the reader to easily access commonly seen disease processes that are nicely updated and categorized in this opus.

However, this is not a standard textbook with standard coverage. It goes much beyond that. The first section describes the theories and science behind several techniques including the newest, "electroporation," which is so new that few monographs have described it. The second part of the book explores an area which is extremely important, but is not discussed in enough detail in most books. These include the development of clinical practice, the interaction with anesthesia, and patient management issues in cancer patients who are undergoing these techniques. This is one of the more neglected areas of discussion in most books and one of the most difficult parts of any interventional oncology procedure. The total management of the patient is not an area which is well discussed or taught in the review courses set up in most societal meetings.

The format is both readable and practical in that the book is divided into both organ-based topics such as liver, kidney, and lung and specific topics that the reader can turn to such as treatment of metastasis; the chapter on "alternatives and novel therapies of the liver" is a great example of the total scope

of the book; where else can you get a review of cryotherapy of liver or the use of laser therapy? The senior authors are all world-renowned experts in interventional oncology which is another example of the high-quality authorship and experience that is brought to this book.

The later chapters discuss therapies that are simply not covered in any other source: Everyone who is doing or wants to do ablation therapies and interventional oncology will face a time when they will be asked to use their expertise in less used and less investigated areas. There is nowhere else where the reader can get information on the prostate, breast, gynecologic areas, and especially pediatrics. These chapters offer an outstanding compliment to the basic material described earlier in the book.

This book is an outstanding contribution to the literature and will become a "must read" for all physicians who are interested in interventional oncology.

Boston, Massachusetts
USA

Peter R. Mueller, MD

Preface

Multidisciplinary care for cancer is no longer just surgery, chemotherapy, and radiotherapy. Interventional oncology is a rapidly growing field that is already indispensible in the care of the patient with a malignancy. Needle- and catheter-based therapies provide palliation of symptoms, cyto-reduction in cases of incurable cancers, and potential cure in cancers discovered at an early enough stage. This book is an attempt at summarizing the state of the art in terms of physical and biologic basis of practice and current clinical delivery. This book does not only present the data for use of interventional procedure, but also tries to placed these procedures within the context of other modalities for treatment of cancer.

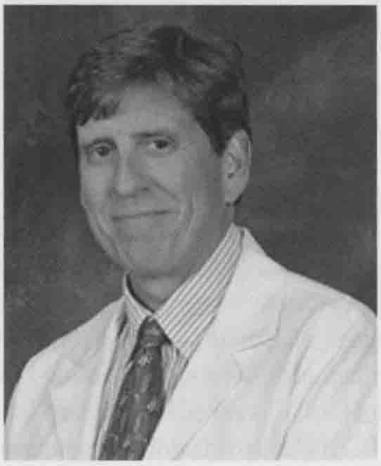
The authorship of this book includes surgeons, oncologists, radiation therapists, in addition to the leaders in interventional radiology. It is an authorship that reflects the multidisciplinary nature of the book and of the field of cancer care. We, the editors, thank the contributors for writing their thorough chapters in a timely fashion while juggling their day-to-day activities of being busy clinicians and scientists. We understand how busy professionals have ever-changing lives and ever-increasing tasks related to their jobs and personal life may make it hard to "write another chapter." Our book, *Image-Guided Cancer Therapy: A Multidisciplinary Approach*, is a testament to the patience, understanding, and hard work of the editors, associate editors, section editors, and authors, for without whom this book would never have come to completion. We all share a vision that having the current practice of interventional oncology summarized in a comprehensive textbook is timely and important.

We would be remiss not to thank our families, loved ones, coworkers and support staff whose love and support allowed us to take the extra time needed to bring together this important body of work which we feel is a very comprehensive source of information for cancer practitioners today. Thus, to our wives Cathy, Nicole, and Kris, we particularly say thanks. We would also be negligent if we didn't thank the thousands of courageous cancer patients who have undergone some of these advanced therapies as part of clinical trials or as part of their cancer care. As with many fields that rely on state-of-the-art technology, this field is rapidly growing and changing.

Hopefully, this book is the first of many future editions that addresses this ever-changing , evolving, and exciting field of medicine.

Damian E. Dupuy, MD, FACR
Yuman Fong, MD, FACS
William N. McMullen

Editors



Damian E. Dupuy, MD, FACR, Director of Tumor Ablation, Department of Diagnostic Imaging, Rhode Island Hospital, The Warren Alpert Medical School of Brown University, Providence, Rhode Island, USA

Damian E. Dupuy is the director of tumor ablation at Rhode Island Hospital and a professor of diagnostic imaging at The Warren Alpert Medical School of Brown University.

Dr. Dupuy received his medical degree from the University of Massachusetts Medical School in 1988 and completed his residency in radiology at The New England Deaconess Hospital and Harvard Medical School in 1993. After residency Dr. Dupuy joined the staff at Massachusetts General Hospital where he worked in the Abdominal Imaging and Bone and Joint Divisions.

In 1997 Dr. Dupuy joined the Department of Diagnostic Imaging at Rhode Island Hospital and Brown University.

Dr. Dupuy, a pioneer in the use of image-guided ablation, helped broaden clinical applications to successfully combat cancer involving the kidney, liver, lung, head and neck, adrenal, and skeleton. Other newer technologies such as percutaneous microwave ablation, cryoablation, and combination therapies using RFA with external radiation or brachytherapy have been pioneered by Dr. Dupuy, who has been the principal investigator of two multicenter trials funded by the National Cancer Institute.

Dr. Dupuy has received national awards for research and teaching from the American College of Radiology Imaging Network and the Radiological Society of North America (RSNA) where he is currently the chair of the Interventional Oncology Symposium featured at the Annual Meeting of the RSNA and fellow of the American College of Radiology.

Dr. Dupuy is a member of the RSNA, The New England Roentgen Ray Society, the American College of Radiology, Rhode Island Radiological Society, and the Society of Interventional Radiology.

Dr. Dupuy has published over 150 publications and given over 120 invited lectures in the field of radiology and image-guided ablation both nationally and internationally.

Yuman Fong, MD, Murray F. Brennan Chair in Surgery, Department of Surgery and Radiology, Memorial Sloan Kettering Cancer Center, New York, New York, USA

Dr. Yuman Fong is an attending surgeon at the Memorial Sloan-Kettering Cancer Center (MSKCC), where he holds the Murray F. Brennan Chair in Surgery. He is a professor of surgery at Weill Cornell Medical College. Dr. Fong received a B.A. in medieval literature from Brown University in 1981, and an M.D. from Cornell University Medical College in 1984. This was followed by surgical training at the New York Hospital/Cornell Medical Center and a surgical oncology fellowship at MSKCC.

Dr. Fong is best known clinically for his extensive work in the field of hepatobiliary surgery—especially for hepatocellular carcinoma, hepatic metastases from colorectal cancer, gallbladder cancer, cholangiocarcinoma, and pancreatic cancer. He has pioneered many surgical, laparoscopic, and ablative therapies for these cancers.

Dr. Fong leads an active laboratory studying the use of genetically modified viruses for the killing of cancer. He was one of the first investigators to administer engineered viruses into the blood stream of humans for treatment of cancer. He is active at coordinating trials of such novel viruses in international clinical trials.

Dr. Fong has co-authored over 600 peer-reviewed articles and 11 textbooks. He has been on the editorial boards of 14 journals. He is a member of numerous scientific and medical societies including the American Surgical Association, Southern Surgical Association, and American Society for Clinical Investigation. He has received many honors and awards including the James IV Surgical Traveler, and the Shipley Award from the Southern Surgical Association. He has served on the board of the Society for Surgery of the Alimentary Tract and the board of the James IV Society of Surgeons. He is currently Chair of the recombinant DNA advisory committee of the National Institutes of Health.

William N. McMullen, Owner/Consultant, McMullen Consulting, LLC, Surprise, Arizona, USA

Bill McMullen is currently the owner and consultant for McMullen Consulting, LLC. In this role, he provides technical advice, clinical guidance, and market analysis for companies and investors, competitive product assessment, risk analysis, FDA, and global regulatory guidance.

McMullen started out his career in the mid-1970s working to promote and launch ultrasound as a diagnostic tool for physicians. Later, he was a part of the pioneering team to develop the first U.S. Food and Drug Administration (FDA)-cleared ultrasound contrast agent. Remaining true to his ultrasound background, he assisted in the development of the first laparoscopic ultrasound system in the United States for surgeons.

McMullen continued his work acquiring global experience developing thermal ablative techniques in the fields of radiology, surgery, and interventional oncology; specializing in device operations, prototyping, technology assessment, clinical education, and commercialization at a senior level for leading companies.

McMullen's past experience included serving as vice president, Ablation Market Development, DFINE, Inc., senior vice president of interventional oncology for Microsulis Medical (Acquired by AngioDynamics), director of operations – tumor ablation at Radionics (now Covidien), and director of clinical marketing for RITA Medical Systems (also acquired by AngioDynamics, Inc.). In these roles, he helped develop and launch the first FDA-cleared RF ablation system and coordinated worldwide sales, marketing, clinical trials, customer education, manufacturing, regulatory, and engineering operations for RF ablation products.

McMullen is the founder and co-program director for Fire, Ice & Beyond: The Future of Interventional Oncology. This program involves some of the world's foremost clinicians and institutions interested in adding ablation therapies and interventional programs to a radiology or surgical practice. He sits on several editorial and review boards and has coedited highly regarded publications, including *Tumor Ablation: Principles and Practice*

and *Image-Guided Cancer Therapy: A Multidisciplinary Approach.* In addition, he is the founder and administrator of Radiological Society of North America Working Group on Image-Guided Tumor Ablation, an international consortium composed of like-minded physicians, scientists, and dedicated to investigating the potential uses of image-guided tumor ablation therapies.

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