Radiation Therapy for Skin Cancer

Armand B. Cognetta Jr
William M. Mendenhall
Editors

Springer

Radiation Therapy for Skin Cancer

Armand B. Cognetta Jr. • William M. Mendenhall
Editors

Radiation Therapy for Skin Cancer

Springer

Editors
Armand B. Cognetta Jr.
Dermatology Associates of Tallahassee
Chief, Division of Dermatology
Florida State University College of Medicine
Tallahassee, FL, USA

William M. Mendenhall
Department of Radiation Oncology
College of Medicine
University of Florida
Gainesville, FL, USA

ISBN 978-1-4614-6985-8 ISBN 978-1-4614-6986-5 (eBook)
DOI 10.1007/978-1-4614-6986-5
Springer New York Heidelberg Dordrecht London

Library of Congress Control Number: 2013937942

Printed on acid-free paper

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

This book is dedicated to all present and previous editors and contributors, to our trusted colleagues and coworkers, to all of our families, and specifically to our wives Nancy and Suzanne who continue to inspire us.

Preface

In reading the preface of *Radiation Treatment and Radiation Reactions in Dermatology* by Renato Pannizon M.D. and Jay Cooper M.D. (Springer 2004), we are reminded that we are following a great work which has been the standard textbook for radiation therapy of skin neoplasms for the last 10 years. It is a very succinct work with renowned contributors and expert editing which, through its various reprints, has guided dermatologists around the world for the last decade.

When asked to become editors of this 2013 edition of *Radiation Therapy for Skin Cancer* we knew it would be a hard task to equal their success. We decided that this text would continue to serve as a primer on the physics, radiobiology, and practical aspects of radiation therapy as it applies to appropriate treatment planning for patients with select tumors. We expanded the chapters on patient selection and fractionation to include flexible guidelines for calculating, and if necessary, adjusting the TDF (Time Dose and Fractionation) as well as other practical additions. In addition, we greatly expanded the chapters dealing with high risk tumors and their management by radiation oncologists. It is hoped that the specific chapters on high risk squamous cell carcinoma, Merkel cell carcinoma, angiosarcoma, lymphomas, and adjuvant radiation for melanoma will be a useful reference for all cutaneous oncologists.

The list of those to thank for their assistance and support is too long for this preface. The overall goal of this book is to aid practitioners in the safe, effective, and judicious use of this time-honored treatment method. We also believe that the continued collaboration of radiation oncologists and dermatologists will result in further knowledge and refinements of the radiobiology and physics of radiation and its broad spectrum and untapped potential. We hope this will result in this modality being more recognized and utilized by knowledgeable practitioners in both of our specialties for our increasingly aging and frail patients.

Tallahassee, FL, USA — Armand B. Cognetta Jr.
Gainesville, FL, USA — William M. Mendenhalll

Contents

Contributors

Murad Alam Department of Dermatology, Northwestern University Feinberg School of Medicine, Chicago, IL, USA

Jeffrey Bennett Department of Radiology, University of Florida, Gainesville, FL, USA

Armand B. Cognetta Jr. Dermatology Associates of Tallahassee, Chief, Division of Dermatology, Florida State University College of Medicine, Tallahassee, FL, USA

Michele N. Edison Florida State University, Tallahassee, FL, USA

Jeremy L. Edwards Dermatology Associates of Tallahassee, Tallahassee, FL, USA

Kerry M.W. Fike Dermatology Associates of Tallahassee, Tallahassee, FL, USA

W. Harris Green Division of Dermatology, Florida State University College of Medicine, Tallahassee, FL, USA

Bradford S. Hoppe Department of Radiation Oncology, University of Florida Proton Therapy Institute, University of Florida, Jacksonville, FL, USA

Carolyn M. Johns Smilow Cancer Hospital Care Center, Guilford, CT, USA

David E. Kent Dermatologic Surgery Specialists, PC, Macon, GA, USA

Jeffrey M. Long Pearlman Comprehensive Cancer Center, South Georgia Medical Center, Valdosta, GA, USA

Nancy P. Mendenhall Department of Radiation Oncology, University of Florida Proton Therapy Institute, University of Florida, Jacksonville, FL, USA

William M. Mendenhall Department of Radiation Oncology, College of Medicine, University of Florida, Gainesville, FL, USA

Kenneth F. Morse Clinical Applications, Sensus Healthcare, Boca Raton, FL, USA

Rosalind Sandell Loyola University Chicago Stritch School of Medicine, Maywood, IL, USA

Thomas Shakar Dermatology Associates of Tallahassee, Tallahassee, FL, USA

Christopher M. Wolfe Lake Erie College of Osteopathic Medicine, Erie, PA, USA

History of Radiation Therapy in Dermatology

W. Harris Green and Thomas Shakar

On November 8, 1895, a German physicist and professor named Wilhelm Roentgen conducted some experiments with a cathode ray tube that led him to discover "eine neue Art von Strahlen"—"a new kind of rays" [1]. He chose the term X-*strahlen*—"X-rays" as the type of rays because the frequency and characteristics of these rays were unknown. He had made the discovery when observing that the invisible cathode rays caused a fluorescent effect on a small cardboard screen painted with barium platinocyanide. The intensity of the fluorescence was diminished proportionally by distances and by certain filter materials of various thicknesses. Roentgen was later awarded the first Nobel Prize for physics in 1901 for his efforts and a bustling new era of applied physical science was spawned from the discovery and development of the X-rays.

The discovery of X-rays also generated interest in natural sources of radiation such as the study of visibly fluorescent compounds. In 1896 Becquerel discovered that radiation was naturally occurring in all uranium compounds. After an initially unsuccessful attempt to induce fluorescence, Becquerel placed the uranium salts and the photographic plates used in his experiments in a drawer with plans to recommence the experiment at a later date. Months later when he developed the photographic plate, he discovered a darkened area which could only be explained by something intrinsic to the uranium salts. Maria Curie furthered this research by testing various materials and discovered that compounds containing thorium also exhibited radioactive properties. Pierre Curie and his brother Paul-Jacques Curie subsequently created a device known as the piezoelectrometer which allowed study

W.H. Green (✉)
Division of Dermatology, Florida State University College of Medicine, 1707 Riggins Road, Tallahassee, FL 32308, USA
e-mail: DATresearch@gmail.com

T. Shakar
Dermatology Associates of Tallahassee, 1707 Riggins Road, Tallahassee, FL 32308, USA

A.B. Cognetta and W.M. Mendenhall (eds.), *Radiation Therapy for Skin Cancer*,
DOI 10.1007/978-1-4614-6986-5_1,

of the intensity of radioactive emissions. While studying the substance, pitchblende, Marie and her husband Pierre Curie discovered emissions that were too intense to be explained by the amount of known uranium in the substance. Through careful experimentation, they isolated a new element polonium (after Maria's home country) and soon after came the discovery of radium. The Nobel Prize for physics was later awarded to Becquerel, Maria, and Pierre [2].

The similarity of radium's effect on the skin to that of the X-ray was noted in 1901 by Pierre Curie and Becquerel following the work of German scientists Giesel and Walkoff which ultimately gave rise to Brachytherapy (from the Greek word brachys, meaning "short"). Brachytherapy involves the placement of the radiation source inside or in short proximity to the lesion or skin condition to be treated. A more detailed history of Brachytherapy can be found at the beginning of Chap. 13.

Less than a year after the discovery, X-rays began to be used in the treatment of skin disease. The first reported use of X-rays for the treatment of a disease of the skin was done by Leopold Fruend of Vienna in 1896 on a nevus pigmentosus piliferus located on the back of a 5-year-old girl. Multiple reports surfaced describing the efficacy of X-rays in the treatment of skin cancers, including J.W. Pugh's article in 1902 entitled, "Four Cases of Rodent Ulcer Treated by X Rays," in which before- and after-photographs were displayed [3] (Fig. 1). A year later in 1903, a British dermatologist named Sequeira reported similar success in treating a longstanding, biopsy-proven BCC of the right ala of a 31-year-old female with before- and after-photographs [4] (Fig. 2). With multiple early reports of success treating skin cancers with X-rays and a tremendous enthusiasm for its potential, Pusey, an American dermatologist attempted to formulate an appropriate therapeutic window for this new, powerful, and potentially dangerous modality in his lecture entitled "Rationale of and the Indications for Therapeutic Use of Rontgen Rays," given at the 27th Annual Meeting of the American Dermatology Association in Washington on May 13th and 14th, 1903. This new treatment modality proved to be a tremendous dermatologic breakthrough affording success in treating numerous previously recalcitrant skin cancers and diseases.

Although the initial cathode ray tubes were somewhat erratic and unreliable in regard to the quality and intensity of their beams, new innovations in technology allowed for greater control of X-ray delivery via cathode ray tubes. In 1913 Coolidge introduced a modification of the cathode ray tube by increasing the vacuum and using a tungsten anode. These improvements allowed for a more reliable machine that could operate at higher voltages (150 kV) for longer periods of time. This led to the eventual development of a 200 kV machine in 1922 which enabled physicians to treat deeper tumors [4]. With the advent of these more reliable tubes, dermatologists such as George Miller MacKee served as pioneers in the field of radiation therapy for skin cancers and provided a benchmark textbook in 1921 entitled "X-Rays and Radium in the Treatment of Skin Disease" which, along with the subsequent editions, proved to be the gold standard for decades to come.

Before the discovery and widespread use of systemic and topical steroids, superficial radiation and Grenz ray therapy were both successfully utilized by dermatologists and non-dermatologists alike in the treatment of several benign yet recalcitrant