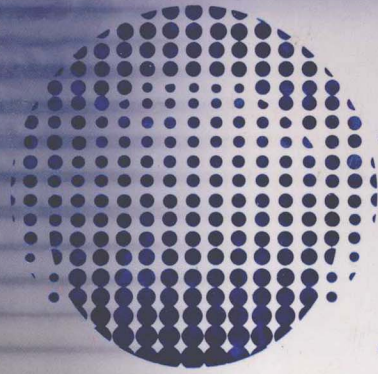
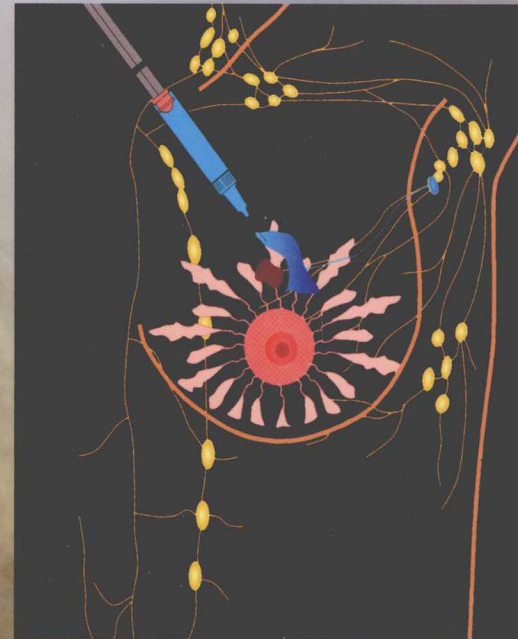
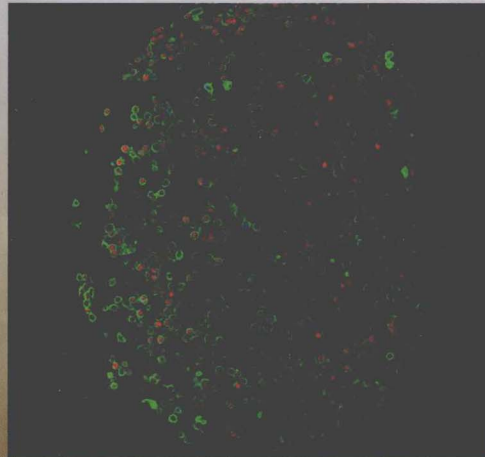
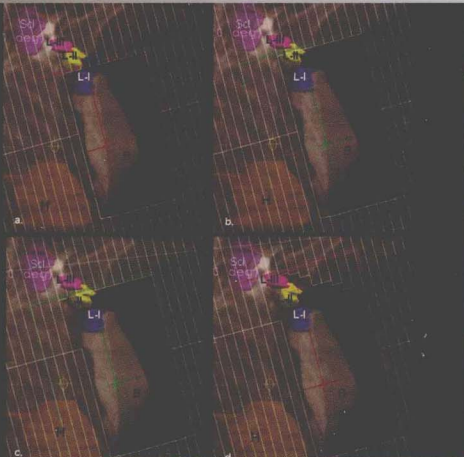


**INCLUDES
Fully
Searchable
Text with
Image Bank!**



Diseases of the **Breast**

F O U R T H E D I T I O N



Jay R. Harris

Marc E. Lippman

Monica Morrow

C. Kent Osborne



Wolters Kluwer | Lippincott Williams & Wilkins
Health

Diseases of the Breast

FOURTH EDITION

Edited by

Jay R. Harris, MD

Professor
Department of Radiation Oncology
Harvard Medical School
Chair
Department of Radiation Oncology
Dana-Farber Cancer Institute and
Brigham Women's Hospital
Boston, Massachusetts

Monica Morrow, MD

Anne Burnett Windfohr Chair of Clinical
Oncology
Chief, Breast Service
Memorial Sloan-Kettering Cancer Center
Professor of Surgery, Weill Medical
College of Cornell University
New York, New York

Marc E. Lippman, MD

Kathleen and Stanley Glaser Professor
Chairman, Department of Medicine
Leonard M. Miller School of Medicine
University of Miami
Miami, Florida

C. Kent Osborne, MD

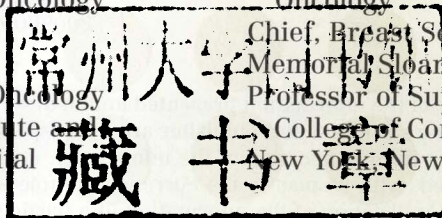
The Tina and Dudley Sharp Chair of
Oncology
Professor of Medicine and Molecular and
Cellular Biology
Director, Dan L. Duncan Cancer Center
Director, Lester and Sue Smith Breast
Center
Baylor College of Medicine
Houston, Texas



Wolters Kluwer | Lippincott Williams & Wilkins

Health

Philadelphia • Baltimore • New York • London
Buenos Aires • Hong Kong • Sydney • Tokyo



Executive Editor: Jonathan W. Pine, Jr.
Associate Director: Joyce Murphy
Project Manager: Alicia Jackson
Senior Manufacturing Manager: Benjamin Rivera
Senior Marketing Manager: Angela Panetta
Designer: Stephen Druding
Cover Designer: Bess Kiethas
Production Service: Aptara, Inc.

© 2010 by LIPPINCOTT WILLIAMS & WILKINS, a WOLTERS KLUWER business
530 Walnut Street
Philadelphia, PA 19106 USA
LWW.com

Third Edition © 2004 Lippincott Williams & Wilkins
Second Edition © 2000 Lippincott Williams & Wilkins
First Edition © 1996 Lippincott Raven

All rights reserved. This book is protected by copyright. No part of this book may be reproduced in any form by any means, including photocopying, or utilized by any information storage and retrieval system without written permission from the copyright owner, except for brief quotations embodied in critical articles and reviews. Materials appearing in this book prepared by individuals as part of their official duties as U.S. government employees are not covered by the above-mentioned copyright.

Printed in China

Library of Congress Cataloging-in-Publication Data

Diseases of the breast / edited by Jay R. Harris . . . [et al.]. — 4th ed.
p. ; cm.

Includes bibliographical references and index.

ISBN 978-0-7817-9117-5

1. Breast—Cancer. 2. Breast—Diseases. I. Harris, Jay R.

[DNLM: 1. Breast Neoplasms—diagnosis. 2. Breast Neoplasms—therapy. 3. Breast Diseases. WP 870 D611 2009]

RC280.B8D49 2009

616.99'449—dc22

2009009897

Care has been taken to confirm the accuracy of the information presented and to describe generally accepted practices. However, the authors, editors, and publisher are not responsible for errors or omissions or for any consequences from application of the information in this book and make no warranty, expressed or implied, with respect to the currency, completeness, or accuracy of the contents of the publication. Application of the information in a particular situation remains the professional responsibility of the practitioner.

The authors, editors, and publisher have exerted every effort to ensure that drug selection and dosage set forth in this text are in accordance with current recommendations and practice at the time of publication. However, in view of ongoing research, changes in government regulations, and the constant flow of information relating to drug therapy and drug reactions, the reader is urged to check the package insert for each drug for any change in indications and dosage and for added warnings and precautions. This is particularly important when the recommended agent is a new or infrequently employed drug.

Some drugs and medical devices presented in the publication have Food and Drug Administration (FDA) clearance for limited use in restricted research settings. It is the responsibility of the health care provider to ascertain the FDA status of each drug or device planned for use in their clinical practice.

To purchase additional copies of this book, call our customer service department at (800) 638-3030 or fax orders to (301) 223-2320. International customers should call (301) 223-2300.

Visit Lippincott Williams & Wilkins on the Internet: at LWW.com. Lippincott Williams & Wilkins customer service representatives are available from 8:30 am to 6 pm, EST.

10 9 8 7 6 5 4 3 2 1

To the many thousands of women with breast cancer or at risk for the disease who participated in randomized clinical trials, without whom the improvements in care and a decrease in breast cancer mortality would not have been achieved.

Preface

The previous three editions of *Diseases of the Breast* were intended as up-to-date, single-source multidisciplinary compilations of important knowledge on breast diseases, with a focus on breast cancer, presented in a form accessible to practicing clinicians. We have been gratified by the success of this effort, and for the fourth edition, we have similarly invited a diverse and distinguished group of experts to summarize the current knowledge about benign and malignant breast diseases, including their biology and epidemiology, clinical features, and management. The underlying premise for this book has been that multidisciplinary care of the breast cancer patient is critical to achieve the best outcomes; furthermore, effective communication between pathologists, breast imagers, medical geneticists, nurses, psychologists, social services, and rehabilitation specialists as well as surgical, medical, and radiation oncologists is essential.

This fourth edition comes at a time when considerable progress has been made in the treatment of breast cancer. In the United States and in Western Europe, there has been a substantial decrease in the death rate from the disease, attributable to early detection with screening mammography and increasingly effective systemic treatment. It is now established that effective local treatment is also essential to decrease breast cancer mortality in addition to optimal local control. A key contributor to this decrease in breast cancer mortality has been the willingness of many thousands of women with breast

cancer to participate in clinical trials and this edition is dedicated to them. Efforts have also been made to understand and improve the quality of life of breast cancer patients. The widespread use of sentinel node biopsy as an alternative to axillary lymph node dissection is a prominent example. Systemic therapy is increasingly targeted and less toxic, and advances in the molecular characterization of breast cancers have begun to explain the heterogeneity of the disease and allow for individualization of treatments. Radiation treatment has advanced by better incorporation of imaging modalities and more sophisticated irradiation techniques. While there has been progress in the treatment of breast cancer, many patients still die of the disease. Continued research into the biology, genetics, prevention, early diagnosis, and treatment of the disease is mandatory.

We hope that the Fourth Edition of *Diseases of the Breast* will be a useful resource for both clinicians and translational investigators. We highlight the rapid and substantial progress that has been made since the last edition that has reduced breast cancer mortality and provides optimism for additional advances in the near future.

Jay R. Harris, MD
Marc E. Lippman, MD
Monica Morrow, MD
C. Kent Osborne, MD



Preface to the First Edition

Interest in and knowledge about breast diseases, especially breast cancer, have increased greatly in recent years. A number of factors have contributed to this, the foremost of which are the high occurrence of breast cancer in westernized countries and the dramatic upswing in this incidence during the past few decades. Clinical investigators have also helped define various benign diseases of the breast and have described their management and relation to subsequent breast cancer development. Moreover, clinical trials performed throughout the world have contributed considerable information about the early detection and management of breast cancer using surgery, radiation therapy, and systemic therapies, including chemotherapy and hormonal interventions. Finally, rapid advances in the understanding of the molecular biology and genetics of both normal tissues and cancers have raised optimism that new, more specific methods can be developed to identify a woman's risk for breast cancer, to prevent or at least detect the disease at an earlier stage, and, failing this, to cure it with minimal toxicity. Ultimately a source of hope, these factors have nevertheless caused considerable anxiety in the population, as well as provided a proliferation of information important for clinicians dealing with diseases that strike the breast.

Diseases of the Breast is intended as a single-source compilation of the new knowledge on breast diseases presented in a form accessible to practicing clinicians. Although it is widely recognized that multidisciplinary interaction and information sharing are essential to effective clinical management of diseases of the breast, new developments are rapidly demonstrating that clinicians also need to be knowledgeable about

advances in basic science. A prominent example of how advances in basic science can rapidly enter the clinical arena is the discovery of the first genetic mutations at specific loci shown to be associated with a high risk of breast cancer. Clinicians are now faced with patient questions about the nature and meaning of such testing as well as its risks and benefits. We believe that other advances in basic science will quickly be reflected in clinical practice.

For *Diseases of the Breast*, we invited a large, diverse, and distinguished group of experts to summarize the current knowledge about breast diseases, including clinical features, management, and underlying biologic and epidemiologic factors. In assembling these contributions, we have tried to make the book comprehensive and timely, as well as accessible to practicing clinicians. We believe that this book will also be an aid to basic and translational scientists concerned about a breast cancer problem by providing clinical information that can help focus their energies and talents. We hope that *Diseases of the Breast* will be a useful resource for both clinicians and scientists and will foster the understanding and communication necessary to provide optimal patient care and to rapidly achieve advances in managing diseases of the breast, especially breast cancer.

Jay R. Harris, MD
Marc E. Lippman, MD
Monica Morrow, MD
Samuel Hellman, MD

Contributors

Albert J. Aboulafia, MD, MBA

Assistant Clinical Professor
Department of Orthopaedic Surgery
University of Maryland
Co-Director Sarcoma Services
Department of Orthopaedic Surgery
Alvin and Lois Lapidus Cancer Center
Sinai Hospital of Baltimore
Baltimore, Maryland

David H. Abramson, MD

Associate Professor
Department of Surgery
New York Presbyterian Hospital
Weill-Cornell Medical College
Chief
Department of Surgery
Memorial Sloan-Kettering Cancer Center
New York, New York

D. Craig Allred, MD

Professor
Department of Pathology and
Immunology
Washington University School of Medicine
Section Head
Department of Pathology
Washington University-Barnes Jewish
Hospital
St. Louis, Missouri

Benjamin Olney Anderson, MD

Professor
Department of Surgery
University of Washington
Director
Department of Breast Health Clinic
Seattle Cancer Care Alliance
Seattle, Washington

Carlos L. Arteaga, MD

Professor of Medicine and Cancer
Biology
Vanderbilt University
Director, Breast Cancer Program
Vanderbilt-Ingram Cancer Center
Nashville, Tennessee

Douglas W. Arthur, MD

Professor
Vice Chairman
Department of Radiation Oncology
Virginia Commonwealth University
Medical College of Virginia Hospitals
Richmond, Virginia

Alan Ashworth, PhD, FRS

Director
Breakthrough
Institute of Cancer Research
London, United Kingdom

Alvaro Moreno Aspitia, MD

Assistant Professor of Medicine
Department of Hematology/Oncology
Mayo Clinic
Jacksonville, Florida

Evandro de Azambuja, MD, PhD

Medical Director
Department of Breast Data Centre
Jules Bordet Institute
Brussels, Belgium

José Baselga, MD

Professor of Medicine
Vall d'Hebron University Hospital
Universitat Autònoma de Barcelona
Chariman
Vall d'Hebron Institute of Oncology
(VHIO)
Vall d'Hebron University Hospital
Barcelona, Spain

Jennifer R. Bellon, MD

Assistant Professor
Department of Radiation Oncology
Harvard Medical School
Attending Physician
Department of Radiation Oncology
Dann-Farber Cancer Institute and
Brigham and Women's Hospital
Boston, Massachusetts

Janet Sybil Biermann, MD

Associate Professor
Director of Musculoskeletal Oncology
Department of Orthopaedic Surgery
University of Michigan
Ann Arbor, Michigan

Richard J. Bleicher, MD

Co-Director, Breast Fellowship
Program
Associate Member
Department of Surgical Oncology
Fox Chase Cancer Center
Philadelphia, Pennsylvania

Susan K. Boolbol, MD

Assistant Professor of Surgery
Department of Surgery
Albert Einstein Medical College
Bronx, New York
Chief
Appel-Venet Comprehensive
Breast Service
Beth Israel Medical Center
New York, New York

Glenn D. Braunstein, MD

Professor and Chairman
Department of Medicine
Cedar-Sinai Medical Center
Los Angeles, California

R. James Brenner, MD, JD

Professor
Department of Radiology
University of California-San Francisco
San Francisco, California
Director
Department of Breast Imaging
Bay Imaging Consultants-Alta Eden
Division
Carol Ann Read Breast Health Center
Oakland, California

Thomas A. Buchholz, MD

Professor and Chair
Department of Radiation Oncology
The University of Texas M.D. Anderson
Cancer Center
Houston, Texas

Nigel James Bundred, MD

Professor of Surgical Oncology
Department of Academic Surgery
University of Manchester
Consultant Surgeon
Nightingale Centre
Wythenshawe Hospital
Manchester, United Kingdom

Kristine Elizabeth Calhoun, MD

Assistant Professor
Department of Surgery
University of Washington
Assistant Professor
Department of Surgery
University of Washington Medical Center
Seattle, Washington

François Campana, MD

Chief of Service
Department of Radiotherapy
Institute Curie
Paris, France

Lisa A. Carey, MD

Associate Professor
Department of Medicine
University of North Carolina-Lineberger
Comprehensive Cancer Center
Medical Director
University of North Carolina Breast
Center
University of North Carolina Hospitals
Chapel Hill, North Carolina

Robert W. Carlson, MD

Professor of Medicine
Department of Medicine
Stanford University
Professor of Medicine
Department of Medicine
Stanford Hospital and Clinics
Stanford, California

Jenny C. Chang, MD

Professor
Breast Center
Baylor College of Medicine
Medical Director
Lester and Sue Smith Breast Center
Baylor Clinic
Houston, Texas

Nathan I. Chorney, MBBS

Associate Professor of Medicine
Department of Medicine
Ben Gurion University of the Negev
Norman Levan Chair of Humanistic
Medicine
Director of Cancer Pain and Palliative
Care
Department of Cancer Medicine
Shaare Zedek Medical Center
Jerusalem, Israel

Andrea L. Cheville, MD, MSLE

Associate Professor
Senior Associate Consultant
Department of Physical Medicine and
Rehabilitation
Mayo Clinic
Rochester, Minnesota

Rowan T. Chlebowski, MD, PhD

Professor of Medicine
Davis Geffen School of Medicine
at UCLA
Los Angeles, California
Chief
Division of Medical Oncology and
Hematology
Harbor-UCLA Medical Center
Torrance, California

Hiram S. Cody III, MD

Professor
Department of Clinical Surgery
Weill Medical College of Cornell
University
Attending Surgeon
Breast Service
Department of Surgery
Memorial Sloan-Kettering Cancer
Center
New York, New York

Sara Cohen, OTR/L, CLT-LANA

Occupational Therapist Specialist
Department of Breast Service
Memorial Sloan-Kettering
Cancer Center
New York, New York

Graham A. Colditz, MD, PhD

Niess-Gain Professor of Medicine
Associate Director
Department of Surgery
Washington University School of
Medicine
Siteman Cancer Center
St. Louis, Missouri

Laura Christine Collins, MD

Assistant Professor
Department of Pathology
Harvard Medical School
Associate Director
Department of Pathology
Beth Israel Deaconess Medical
Center
Boston, Massachusetts

Steven Come, MD

Associate Professor
Department of Medicine
Harvard Medical School
Associate Clinical Director,
Hematology/Oncology
Department of Medicine
Beth Israel Deaconess Medical
Center
Boston, Massachusetts

Carl D'Orsi, MD

Professor
Department of Radiology, Hematology/
Oncology
Emory University School of Medicine
Director
Division of Breast Imaging Center
Emory University Hospital

Chau T. Dang, MD

Assistant Professor
Department of Medicine
New York Hospital-Cornell Medical
Center
Assistant
Department of Medicine
Memorial Sloan-Kettering Cancer Center
New York, New York

Nancy E. Davidson, MD

Director
University of Pittsburgh Cancer Institute
Hillman Professor of Medicine
University of Pittsburgh
Director
University of Pittsburgh Medical Center
Cancer Centers
University of Pittsburgh Medical Center
Pittsburgh, Pennsylvania

Lisa M. DeAngelis, MD

Professor
Department of Neurology
Weill Cornell Medical School
Chair
Department of Neurology
Memorial Sloan-Kettering Cancer Center
New York, New York

Angela DeMichele, MD, MSCE

Assistant Professor
Department of Medicine and
Epidemiology
Co-Leader, Breast Cancer Program
Abramson Cancer Center
University of Pennsylvania
Philadelphia, Pennsylvania

Deborah A. Dillon, MD

Assistant Professor
Staff Pathologist
Department of Pathology
Harvard Medical School
Brigham and Women's Hospital
Boston, Massachusetts

J. Michael Dixon, BSC(HOM), MBChB, MD, FRCS, FRCSGD, FRCPGD(HOM)

Professor
Department of Surgery
Edinburgh Breast Unit
University of Edinburgh
Consultant Breast Surgeon
Edinburgh Breast Unit
Western General Hospital
Edinburgh, Scotland



- Susan M. Domchek, MD**
Associate Professor
Department of Medicine
University of Pennsylvania
Director
Cancer Risk Evaluation Program
Abramson Cancer Center
Philadelphia, Pennsylvania
- Melinda Epstein, PhD**
Department of Pathology
University of Southern California
Los Angeles, California
- Francisco J. Esteva, MD, PhD**
Associate Professor
Department of Medicine, Breast Medical
Oncology
The University of Texas M.D. Anderson
Cancer Center
Houston, Texas
- Kathryn Evers, MD**
Clinical Associate Professor
Department of Diagnostic Imaging
Temple University
Director of Breast Imaging
Department of Diagnostic Imaging
Fox Chase Cancer Center
Philadelphia, Pennsylvania
- Rebecca Fisher, MD**
Department of Neurology
Memorial Sloan-Kettering Cancer Center
New York, New York
- David A. Flockhart, MD, PhD**
Professor
Division of Clinical Pharmacology
Medical Genetics School of Medicine
Indiana University School of Medicine
Chief
School of Medicine
Division of Clinical Pharmacology School
of Medicine
IU Simon Cancer Center
Indianapolis, Indiana
- Alain Fourquet, MD**
Chief
Department of Radiation Oncology
Institute Curie
Paris, France
- Matthew T. Freedman, MD, MBA**
Associate Professor
Department of Oncology
Lombardi Comprehensive Cancer
Center
Georgetown University Medical
Center
Washington, D.C.
- Ronnie John Freilich, MD**
Neurologist
Department of Neurology
Monash Medical Centre
Melbourne, Australia
- Suzanne A. W. Fuqua, PhD**
Professor
Department of Medicine and Molecular
and Cellular Biology
Lester and Sue Smith Breast Center
Baylor College of Medicine
Houston, Texas
- Susan M. Gapstur, MPH, PhD**
Professor
Department of Preventive Medicine
Northwestern University
Chicago, Illinois
- Richard D. Gelber, PhD**
Professor
Department of Biostatistics
Harvard School of Public Health
Senior Biostatistician
Department of Biostatistics
Dana-Farber Cancer Institute
Boston, Massachusetts
- Shari Gelber, MS, MSW**
Biostatistician
Adult Oncology
Dana-Farber Cancer Institute
Boston, Massachusetts
- Christophe Ginestier, PhD**
Department of Internal Medicine
Hematology/Oncology
University of Michigan Cancer Center
Ann Arbor, Michigan
- Elizabeth S. Ginsburg, MD**
Associate Professor
Department of Obstetrics, Gynecology
and Reproductive Biology
Harvard Medical School
Medical Director, Assisted Reproductive
Technologies Program
Department of Obstetrics and
Gynecology
Brigham and Women's Hospital
Boston, Massachusetts
- Armando E. Giuliano, MD**
Clinical Professor of Surgery
University of California
Los Angeles, California
Director
John Wayne Cancer Institute
(Breast Center)
Saint John's Health Center
Santa Monica, California
- Aron Goldhirsch, MD**
Professor of Medical Oncology
University of Bern
Bern, Switzerland
Director
Department of Medicine
European Institute of Oncology (EIO)
Milan, Italy
- Mehra Golshan, MD**
Assistant Professor
Department of Surgery
Harvard Medical School
Director of Breast Surgical Services
Department of Surgery
Brigham and Women's Hospital
Boston, Massachusetts
- William J. Gradishar, MD**
Professor
Department of Medicine
Hematology/Oncology
Northwestern University
Director
Department of Breast Medical Oncology
Northwestern Memorial Hospital
Chicago, Illinois
- Julie R. Gralow, MD**
Associate Professor
Division of Medical Oncology
University of Washington
Director
Department of Breast Medical
Oncology
Seattle Cancer Care Alliance
Seattle, Washington
- Joe W. Gray, PhD**
Associate Laboratory Director for Life
and Environmental Sciences
Life Sciences Division Director
Life Sciences Division
Lawrence Berkeley National Laboratory
Berkeley, California
Adjunct Professor
Department of Laboratory Medicine
Helen Diller Family Comprehensive
Cancer Center
University of California, San Francisco
San Francisco, California
- Baiba J. Grube, MD**
Associate
Department of Surgical Oncology/Breast
Center
Yale Medical School
Breast Surgeon
Department of Surgical Oncology
Yale New Haven Hospital
New Haven, Connecticut
- Anthony J. Guidi, MD**
Chair
Department of Pathology
North Shore Medical Center
Salem, Massachusetts
- Carolina Gutierrez, MD**
Director of the Division of Breast
Pathology
Director of the Division of Prognostic
and Predictive Markers
Associate Professor of Pathology
Baylor College of Medicine
Houston, Texas

Bruce G. Haffty, MD

Professor and Chairman
Chairman/Chief
Department of Radiation Oncology
University of Medicine and Dentistry of
New Jersey
Robert Wood Johnson Medical
School/Cancer Institute of New Jersey
Robert Wood Johnson University
Hospital
New Brunswick, New Jersey

Susan E. Hankinson, ScD

Associate Professor
Department of Medicine
Harvard Medical School
Principal Investigator of the NHS
Department of Chronic Diseases
Brigham & Women's Hospital
Boston, Massachusetts

Nora M. Hansen, MD

Associated Professor
Department of Surgery
Feinberg School of Medicine,
Northwestern University
Director
Lynn Sage Comprehensive Breast Center
Department of Surgery
Prentice Women's Hospital of
Northwestern Memorial Hospital
Chicago, Illinois

Douglas Hanto, MD, PhD

Lewis Thomas Professor of Surgery
Harvard Medical School
Chief
Division of Transplantation
Department of Surgery
Beth Israel Deaconess Medical Center
Boston, Massachusetts

Eleanor E. R. Harris, MD

Associate Professor
Department of Oncologic Sciences
University of South Florida
Associate Member and Clinical Director
Department of Radiation Oncology
H. Lee Moffit Cancer Center and
Research Institute
Tampa, Florida

Jay R. Harris, MD

Professor
Department of Radiation Oncology
Harvard Medical School
Chair
Department of Radiation Oncology
Dana-Farber Cancer Institute and
Brigham & Women's Hospital
Boston, Massachusetts

Daniel F. Hayes, MD

Professor
Department of Internal Medicine
Division of Hematology/Oncology
University of Michigan
Clinical Director
Breast Oncology Program
University of Michigan Comprehensive
Cancer Center
Ann Arbor, Michigan

James A. Hayman, MD, MBA

Professor
Department of Radiation Oncology
University of Michigan
Associate Chair for Clinical Activities
Department of Radiation Oncology
University of Michigan Health System
Ann Arbor, Michigan

Laura Heiser, PhD

Staff Scientist
Division of Life Sciences
Lawrence Berkeley National Laboratory
Berkeley, California

Mark A. Helvie, MD

Professor
Director of Breast Imaging
Department of Radiology
University of Michigan Health System
Ann Arbor, Michigan

Dawn Hershman, MD, MS

Assistant Professor of Medicine and
Epidemiology
Department of Medicine
Columbia University Medical Center
New York, New York

Bruce E. Hillner, MD

Professor of Medicine and Eminent
University Scholar
Department of Internal Medicine
Virginia Commonwealth University
Member
Virginia Commonwealth Cancer Center
and Medical Center
Richmond, Virginia

Susan G. Hilsenbeck, PhD

Professor
Department of Breast Cancer
Baylor College of Medicine
Houston, Texas

Gabriel N. Hortobagyi, MD

Professor and Chair
Department of Breast Medical Oncology
The University of Texas M.D. Anderson
Cancer Center
Houston, Texas

Anthony Howell, MD

Muriel Edith Rickman Chair of Breast
Cancer
Translation Research Facility 2
Paterson Institute for Cancer Research
Medical Oncologist
Medical Oncology
The Christie NHS Foundation Trust
Manchester, United Kingdom

Sacha J. Howell, MD, PhD

Breast Biology Group
Paterson Institute for Cancer
Research
University of Manchester
Honorary Consultant
Department of Medical Oncology
The Christie NHS Foundation Trust
Manchester, United Kingdom

Clifford Hudis, MD

Attending Physician
Department of Medicine
Chief
Breast Cancer Medicine Services
Solid Tumor Division
Department of Medicine
Memorial Sloan-Kettering Cancer
Center
New York, New York

Kevin S. Hughes, MD

Associate Professor
Harvard Medical School
Surgical Director, Breast Screening
Co-Director, Avon Comprehensive
Breast Evaluation Center
Massachusetts General Hospital
Boston, Massachusetts

Kelly K. Hunt, MD

Professor
Department of Surgical Oncology
The University of Texas M.D. Anderson
Cancer Center
Houston, Texas

David J. Hunter, MD, ScD

Vincent L. Gregory Professor of Cancer
Prevention
Departments of Epidemiology and
Nutrition
Harvard School of Public Health
Associate Epidemiologist
Department of Medicine
Brigham and Women's Hospital,
Channing Laboratory
Boston, Massachusetts

Maria D. Iniesta, MD

Department of Internal Medicine
Division of Hematology/Oncology
Comprehensive Cancer Center
University of Michigan Health System
Ann Arbor, Michigan

Claudine Isaacs, MD

Associate Professor
Director, Clinical Breast Cancer Program
Departments of Medicine and Oncology
Georgetown University/Lombardi
Comprehensive Cancer Center
Jess and Mildred Fisher Center for
Familial Cancer Research
Washington, DC

Atif J. Khan, MD

Assistant Professor
Attending Physician
Department of Radiation Oncology
University of Medicine and Dentistry of
New Jersey
Robert Wood Johnson Medical School/
Cancer Institute of New Jersey
Robert Wood Johnson University
Hospital
New Brunswick, New Jersey

Seema A. Khan, MD

Professor
Bluhm Family Professor of Cancer Research
Department of Surgery
Northwestern University/Feinberg School of Medicine
Co-Leader
Breast Program at Robert H. Lurie Comprehensive Cancer Center
Director
Bluhm Family Breast Cancer Early Detection and Prevention Center
Department of Surgery
Northwestern Memorial Hospital
Lynn Sage Comprehensive Breast Center
Chicago, Illinois

Nagi F. Khouri, MD

Associate Professor
Director
Division of Breast Imaging
Department of Radiology and Oncology
The Johns Hopkins University
Director
Division of Breast Imaging
Department of Radiology
The Johns Hopkins Hospital
Baltimore, Maryland

Kandice E. Kilbride, MD

Breast Surgeon
Breast Cancer Alliance of North Texas
Presbyterian Hospital of Dallas
Dallas, Texas

Janice Nam Kim, MD

Assistant Professor
Department of Radiation Oncology
University of Washington
Assistant Professor
Department of Radiation Oncology
Seattle Cancer Care Alliance
Seattle, Washington

Gretchen G. Kimmick, MD, MS

Associate Professor
Breast Oncology
Internal Medicine/Division of Medical Oncology
Department of Internal Medicine/
Division of Medical Oncology
Duke University Medical Center
Durham, North Carolina

Tari A. King, MD

Assistant Professor
Department of Surgery
Weill Medical College of Cornell University
Assistant Attending Physician
Breast Service
Department of Surgery
Memorial Sloan-Kettering Cancer Center
New York, New York

Youlia M. Kirova, MD

Senior Radiation Oncologist
Department of Radiation Oncology
Institute Curie
Paris, France

Rita Kramer, MD

Associate Professor
Lester and Sue Smith Breast Center
Baylor College of Medicine
Houston, Texas

Sunil R. Lakhani, MD

Professor
Department of Molecular and Cellular Pathology School of Medicine
The University of Queensland Centre for Clinical Research
The University of Queensland
Professor
Department of Anatomical Pathology
Pathology Queensland Central
Royal Brisbane and Women's Hospital
Herston, Australia

Thomas J. Lawton, MD

Director
Seattle Breast Pathology Consultants
Seattle, Washington

Constance D. Lehman, MD, PhD

Professor and Vice Chair of Radiology,
Section Head of Breast Imaging
Department of Radiology
University of Washington
Professor and Vice Chair of Radiology,
Section Head of Breast Imaging
Department of Radiology
University of Washington Medical Center
Seattle, Washington

Constance D. Lehman, MD, PhD

Professor and Vice Chair of Radiology
Section Head of Breast Imaging
University of Washington
University of Washington Medical Center
Seattle, Washington

Michael T. Lewis, PhD

Assistant Professor
Department of Molecular and Cellular Biology
Baylor College of Medicine
Houston, Texas

Wenchi Liang, PhD

Assistant Professor
Department of Cancer Control Program
Georgetown University Medical Center
Washington, DC

Jennifer A. Ligibel, MD

Instructor
Department of Medicine
Harvard Medical School
Medical Oncologist
Department of Adult Oncology
Dana-Farber/Brigham and Women's Hospital
Boston, Massachusetts

Nancy U. Lin, MD

Instructor in Medicine
Harvard Medical School
Attending Physician
Department of Medical Oncology
Dana-Farber Cancer Institute
Boston, Massachusetts

Marc E. Lippman, MD

Kathleen and Stanley Glaser Professor
Chairman, Department of Medicine
Leonard M. Miller School of Medicine
University of Miami
Miami, Florida

Jennifer Keating Litton, MD

Assistant Professor
Department of Breast Medical Oncology
The University of Texas M.D. Anderson Cancer Center
Houston, Texas

Shelly S. Lo, MD

Assistant Professor of Medicine
Department of Medicine
Stritch School of Medicine
Assistant Professor
Department of Medicine
Loyola University Chicago
Maywood, Illinois

Charles L. Loprinzi, MD

Professor of Oncology
Director, NCCTG Cancer Control Program
Department of Oncology
Mayo Clinic
Rochester, Minnesota

Yanling Ma, MD

Assistant Professor
Department of Pathology
University of Southern California
Los Angeles, California

Eleftherios P. Mamounas, MD, MPH

Professor
Department of Surgery
Northeastern Ohio Universities College of Medicine
Rootstown, Ohio
Medical Director
Department of Cancer Center
Aultman Health Foundation
Canton, Ohio

Jeanne Mandelblatt, MD, MPH

Associate Director
Department of Oncology
Georgetown University Medical Center
Washington, DC

Robert E. Mansel, MB, MS

Chairman
Department of Surgery
Cardiff University
Chief
Department of Surgery
University Hospital of Wales
Cardiff, United Kingdom

Holly S. Mason, MD

Assistant Professor
Department of Surgery
Tufts University School of Medicine
Boston, Massachusetts
Director
Breast Surgical Services
Department of Surgery
Baystate Medical Center
Springfield, Massachusetts

Mary Jane Massie, MD

Professor
Department of Psychiatry
Weill Medical College of Cornell
University
Attending Psychiatrist
Department of Psychiatry and
Behavioral Sciences
Memorial Sloan-Kettering Cancer Center
New York, New York

Erica L. Mayer, MD, MPH

Instructor
Department of Medicine
Harvard Medical School
Staff Physician
Department of Medical Oncology
Dana-Farber Cancer Institute
Boston, Massachusetts

Craig D. McColl, MD

Staff Specialist in Neurology
Division of Medicine
Calvary Hospital
Bruce, Australia

Beryl A. McCormick, MD

Professor
Department of Medicine
Weill College/Cornell University
Clinical Director
Department of Radiation Oncology
Memorial Sloan-Kettering Cancer Center
New York, New York

Sarah A. McLaughlin, MD

Assistant Professor
Senior Assistant Consultant
Department of Surgery
Mayo Clinic Medical School
Jacksonville, Florida

Karen M. Meneses, PhD

Professor and Associate Dean for
Research
School of Nursing, Center for Nursing
Research
University of Alabama at Birmingham
Birmingham, Alabama

Steven J. Mentzer, MD

Professor
Department of Surgery
Harvard Medical School
Senior Thoracic Surgeon
Department of Surgery
Brigham and Women's Hospital
Boston, Massachusetts

Sofia D. Merajver, MD, PhD

Professor
Department of Internal Medicine
University of Michigan
Ann Arbor, Michigan

Rebecca Miksad, MD, MPH

Instructor
Department of Medicine
Harvard Medical School
Attending Physician
Division of Hematology/Oncology
Department of Medicine
Beth Israel Deaconess Medical Center
Boston, Massachusetts

Kathy D. Miller, MD

Associate Professor
Department of Hematology/Oncology
Indiana University
Indiana University Simon Cancer Center
Indianapolis, Indiana

Monica Morrow, MD

Anne Burnett Windfohr Chair of Clinical
Oncology
Chief, Breast Service
Memorial Sloan-Kettering Cancer Center
Professor of Surgery, Weill Medical
College of Cornell University
New York, New York

Hyman B. Muss, MD

Professor
Department of Medicine
University of North Carolina at Chapel
Hill School of Medicine
Director
Geriatric Oncology
Division of Hematology/Oncology
Lineberger Comprehensive Cancer
Center
Chapel Hill, North Carolina

Mary S. Newell, MD

Assistant Professor
Department of Radiology
Emory University
Assistant Director
Department of Breast Imaging
Emory University Hospital
Atlanta, Georgia

Lisa A. Newman, MD, MPH

Professor
Department of Surgery
University of Michigan
Director
Breast Care Center
University of Michigan Comprehensive
Cancer Center
Ann Arbor, Michigan

Oded Olsha, MBBS

Breast Surgery Unit
Department of Surgery
Shaare Zedek Medical Center
Jerusalem, Israel

C. Kent Osborne, MD

The Tina and Dudley Sharp Chair of
Oncology
Professor of Medicine and Molecular and
Cellular Biology
Director, Dan L. Duncan Cancer Center
Director, Lester and Sue Smith Breast
Center
Baylor College of Medicine
Houston, Texas

Michael P. Osborne, MD, MSurg

Director of Breast Program Continuum
Cancer Centers of New York
Department of Surgery
Beth Israel Medical Center
New York, New York

Sumanta Kumar Pal, MD

Department of Medical Oncology and
Experimental Therapeutics City of
Hope Comprehensive Cancer Center
Duarte, California

Ann H. Partridge, MD, MPH

Assistant Professor
Department of Medicine
Harvard Medical School
Clinical Director, Breast Oncology Center
Department of Medical Oncology
Dana-Farber Cancer Institute
Boston, Massachusetts

Sameer A. Patel, MD

Associate Member, Plastic and
Reconstructive Surgery
Department of Surgical Oncology
Fox Chase Cancer Center
Philadelphia, Pennsylvania

Mark D. Pogram, MD

Professor of Medicine
Department of Medicine, Hematology
Oncology Division
Miller School of Medicine
Miami, Florida

Edith A. Perez, MD

Serene M. and Frances C. Durling
Professor of Medicine
Department of Hematology/Oncology,
Internal Medicine
Mayo Clinic
Jacksonville, Florida

Charles M. Perou, PhD

Associate Professor
Department of Genetics, and Pathology
and Laboratory Medicine
University of North Carolina at Chapel
Hill
Chapel Hill, North Carolina

Beth N. Peshkin, MS, CGC

Associate Professor
Senior Genetic Counselor
Department of Oncology
Georgetown University/Lombardi
Comprehensive Cancer Center
Jess and Mildred Fisher Center for
Familial Cancer Research
Washington, DC

Martine Piccart-Gebhart, MD, PhD

Professor
Department of Oncology
Universite Libre De
Head
Department of Medicine
Jules Bordet Institute
Brussels, Belgium

Michael F. Press, MD, PhD

Professor
Department of Pathology
University of Southern California
Los Angeles, California

Sofyan M. Radaideh, MD

Division of Hematology-Oncology
University of Texas Southwestern
Medical Center
Dallas, Texas

James Michael Rae, PhD

Assistant Professor
Department of Internal Medicine
University of Michigan
Ann Arbor, Michigan

Naren R. Ramakrishna, MD, PhD

Instructor in Radiation Oncology
Radiation Oncology
Harvard Medical School
Chief, Division of CNS Radiation
Oncology
Radiation Department
Brigham and Women's Hospital
Boston, Massachusetts

Priya Rastogi, MD

Assistant Professor
Department of Medicine
University of Pittsburgh
Medical Oncologist
Women's Cancer Center
University of Pittsburgh Cancer Institute
at Magee-Women's Hospital
Pittsburgh, Pennsylvania

Jorge S. Reis-Filho, MD, PhD

Team Leader
Department of Molecular Pathology
The Breakthrough Breast Cancer
Research Center
Institute of Cancer Research
London, United Kingdom

Mothaffar F. Rimawi, MD

Assistant Professor
Lester and Sue Smith Breast Center
Baylor College of Medicine
Houston, Texas

Jeffrey M. Rosen, PhD

C. C. Bell Professor
Department of Molecular and Cellular
Biology
Baylor College of Medicine
Houston, Texas

Susan Orel Roth, MD

Professor
Department of Radiology
University of Pennsylvania School of
Medicine
Hospital University of Pennsylvania
Philadelphia, Pennsylvania

Julia H. Rowland, PhD

Adjunct Associate Professor
Department of Psychiatry
Georgetown University School of
Medicine
Washington, DC
Director, Office of Cancer Survivorship
Division of Cancer Control and
Population Sciences
National Cancer Institute
Bethesda, Maryland

Michael S. Sabel, MD

Associate Professor
Department of Surgery
University of Michigan
Ann Arbor, Michigan

Rachel Schiff, MD

Associate Professor
Department of Medicine
Lester and Sue Smith Cancer Center
Baylor College of Medicine
Houston, Texas

Bryan P. Schneider, MD

Assistant Professor
Department of Hematology/Oncology
Indiana University
Indiana University Simon Cancer Center
Indianapolis, Indiana

Stuart J. Schnitt, MD

Professor
Department of Pathology
Harvard Medical School
Director
Division of Anatomic Pathology
Department of Pathology
Beth Israel Deaconess Medical Center
Boston, Massachusetts

Marc Schwartz, PhD

Associate Professor
Director, Cancer Control
Department of Oncology
Georgetown University/Lombardi
Comprehensive Cancer Center
Jess and Mildred Fisher Center for
Familial Cancer Research
Washington, DC

Brian J. Scott, MD

Clinical Assistant Professor
Department of Neurology
Tufts University
Boston, Massachusetts
Staff Physician
Department of Neurology
Laney Clinic Medical Center
Burlington, Massachusetts

Vanessa B. Sheppard, PhD, MA

Assistant Professor
Department of Oncology
Georgetown University Medical Center
Washington, DC

Lawrence N. Shulman, MD

Associate Professor
Department of Medicine
Harvard Medical School
Chief Medical Officer
Department of Medical Oncology
Dana-Farber Cancer Institute
Boston, Massachusetts

Peter T. Simpson, PhD

Department of Molecular and Cellular
Pathology
The University of Queensland
Herston, Australia

Sonja Eva Singletary, MD

Professor
Department of Surgical Oncology
The University of Texas M.D. Anderson
Cancer Center
Houston, Texas

George W. Sledge, Jr., MD

Professor of Medicine and Pathology
Department of Hematology/Oncology
Indiana University School of Medicine
Co-Director Breast Oncology Team
Department of Hematology/Oncology
Indiana University Simon Cancer Center
Indianapolis, Indiana

Jeffrey B. Smerage, MD, PhD

Assistant Professor
Department of Internal Medicine
University of Michigan Health System
Ann Arbor, Michigan

Ian E. Smith, MD, FRCP, FRCPE

Professor
Department of Medical Oncology,
Breast Unit
The Royal Marsden NHS Foundation
Trust
London, United Kingdom

Robert A. Smith, PhD

Director of Cancer Screening
Department of Cancer Control Sciences
American Cancer Society
Atlanta, Georgia

Lawrence J. Solin, MD

Chairman
Department of Radiation Oncology
Albert Einstein Medical Center
Philadelphia, Pennsylvania

Paul T. Spellman, PhD

Staff Scientist
Division of Life Sciences
Lawrence Berkeley National Laboratory
Berkeley, California

Vered Stearns, MD

Associate Professor
Department of Oncology
Johns Hopkins School of Medicine
Attending Physician
Sidney Kimmel Comprehensive Cancer
Center
Johns Hopkins Hospital
Baltimore, Maryland

Nicole L. Stout, MPT, CLT-LANA

Lead Physical Therapist
Department of Breast Cancer
National Naval Medical Center
Bethesda, Maryland

Eric A. Strom, MD

Professor
Medical Director
Department of Radiation Oncology
Nellie B. Connall Breast Center
The University of Texas M.D. Anderson
Cancer Center
Houston, Texas

Rulla May Tamimi, ScD

Assistant Professor
Department of Medicine
Harvard School of Medicine
Associate Epidemiologist
Channing Laboratory
Brigham and Women's Hospital
Boston, Massachusetts

Sing-Huang Tan, MD

Consultant
Department of Hematology/Oncology
National University Hospital
National University Health System
Singapore

Julia Tchou, MD, PhD

Assistant Professor
Department of Surgery
University of Pennsylvania
Philadelphia, Pennsylvania

Yee Lu Tham, MD

Assistant Professor
Department of Medicine
Baylor College of Medicine
Staff Oncologist
Department of Medicine
Michael E. DeBakey VA Medical Center
Houston, Texas

Richard Lee Theriault, DO

Professor
Department of Breast Medical Oncology
The University of Texas M.D. Anderson
Cancer Center
Houston, Texas

Robert D. Timmerman, MD

Professor and Vice Chair
Department of Radiation Oncology
University of Texas Southwestern
Director of Stereotactic Radiotherapy
Moncrief Radiation Oncology Center
University of Texas Southwestern
Medical Center
Dallas, Texas

Neal Stoddard Topham, MD

Chief Plastic and Reconstructive Surgery
Department of Surgical Oncology
Fox Chase Cancer Center
Philadelphia, Pennsylvania

Susan Urba, MD

Professor
Internal Medicine, Division of
Hematology-Oncology
University of Michigan
Ann Arbor, Michigan

Kimberly J. Van Zee, MS, MD

Professor
Department of Surgery
Weill Medical College of Cornell
University
Attending Surgeon
Department of Breast Service
Memorial Sloan-Kettering Cancer Center
New York, New York

Frank A. Vicini, MD

Clinical Professor
Department of Health Sciences
Oakland University
Rochester, Michigan
Chief of Oncology
Department of Oncology
William Beaumont Hospital
Royal Oak, Michigan

Victor G. Vogel, MD, MHS

Professor of Medicine and Epidemiology
Department of Medicine
University of Pittsburgh School of
Medicine
Director of Breast Cancer Prevention
Program
Women's Cancer Center
Magee Women's Hospital
Pittsburgh, Pennsylvania

Richard B. Wait, MD, PhD

Clinical Professor
Department of Surgery
Tufts University School of Medicine
Boston, Massachusetts
Chairman
Department of Surgery
Baystate Medical Center
Springfield, Massachusetts

Judy Wang, PhD

Assistant Professor
Department of Oncology
Georgetown University Medical Center
Washington, DC

Barbara L. Weber, MD

Vice President of Cancer Research
GlaxoSmith Kline Oncology
Collegeville, Pennsylvania

Susan P. Weinstein, MD

Assistant Professor
Department of Radiology
University of Pennsylvania Medical
Center
Philadelphia, Pennsylvania

Patrick Y. Wen, MD

Associate Professor
Department of Neurology
Harvard Medical School
Clinical Director
Center for Neuro-Oncology
Dana-Farber Cancer Institute Brigham
and Women's Cancer Center
Boston, Massachusetts

Julia R. White, MD

Professor
Radiation Oncology
Medical College of Wisconsin
Froedtert Memorial Lutheran Hospital
Milwaukee, Wisconsin

Max S. Wicha, MD

Distinguished Professor of Oncology
University of Michigan
Director
University of Michigan Comprehensive
Cancer Center
Ann Arbor, Michigan

Walter C. Willett, MD, DrPH

Professor and Chair
Department of Nutrition
Harvard School of Public Health
Boston, Massachusetts

Eric P. Winer, MD

Professor
Department of Medicine
Harvard Medical School
Chief
Division of Women's Cancer
Department of Medical Oncology
Dana-Farber Cancer Institute
Boston, Massachusetts

Kari B. Wisinski, MD

Assistant Professor
Department of Medicine
University of Wisconsin School of
Medicine and Public Health
University of Wisconsin Hospitals and
Clinics
Madison, Wisconsin

Antonio C. Wolff, MD

Associate Professor
Attending Physician
Department of Oncology
Johns Hopkins School of Medicine
Johns Hopkins Hospital
Baltimore, Maryland

Contents

<i>Preface</i>	xv
<i>Preface to the First Edition</i>	xvii
<i>Contributors</i>	xix

Section I Breast Anatomy and Development

Chapter 1	Breast Anatomy and Development <i>Michael P. Osborne and Susan K. Boolbol</i>	1
Chapter 2	Molecular Mechanisms Regulating Breast Development <i>Jeffrey M. Rosen and Michael T. Lewis</i>	12
Chapter 3	Stem Cells in Breast Development and Carcinogenesis: Concepts and Clinical Perspectives <i>Christophe Ginestier and Max S. Wicha</i>	22

Section II Diagnosis and Management of Benign Breast Diseases

Chapter 4	Physical Examination of the Breast <i>Monica Morrow</i>	29
Chapter 5	Management of the Palpable Breast Mass <i>Richard J. Bleicher</i>	32
Chapter 6	Management of Disorders of the Ductal System and Infections <i>J. Michael Dixon and Nigel James Bundred</i>	42
Chapter 7	Management of Breast Pain <i>Robert E. Mansel</i>	52

Chapter 8	Abnormalities of the Breast in Pregnancy and Lactation <i>Richard B. Wait and Holly S. Mason</i>	58
Chapter 9	Management of Gynecomastia <i>Glenn D. Braunstein</i>	62
Chapter 10	Pathology of Benign Breast Disorders <i>Stuart J. Schnitt and Laura Christine Collins</i>	69

Section III Breast Imaging and Image-Guided Biopsy Techniques

Chapter 11	Screening for Breast Cancer <i>Robert A. Smith, Carl D'Orsi, and Mary S. Newell</i>	87
Chapter 12	Imaging Analysis: Mammography <i>Mark A. Helvie</i>	116
Chapter 13	Breast Ultrasound <i>Nagi F. Khouri</i>	131
Chapter 14	Imaging Analysis: Magnetic Resonance Imaging <i>Susan Orel Roth</i>	152
Chapter 15	Imaging: New Techniques <i>Matthew T. Freedman</i>	171
Chapter 16	Image-Guided Biopsy of Nonpalpable Breast Lesions <i>Kathryn Evers</i>	193
Chapter 17	Management Summary on Breast Imaging <i>Monica Morrow</i>	206

Section IV Epidemiology and Assessing and Managing Risk

Chapter 18	Inherited Genetic Factors and Breast Cancer <i>Alan Ashworth, Barbara L. Weber, and Susan M. Domchek</i>	209
Chapter 19	Genetic Testing and Management of Patients with Hereditary Breast Cancer <i>Claudine Isaacs, Beth N. Peshkin, and Marc Schwartz</i>	224
Chapter 20	Nongenetic Factors in the Causation of Breast Cancer <i>Walter C. Willett, Rulla May Tamimi, Susan E. Hankinson, David J. Hunter, and Graham A. Colditz</i>	248

Chapter 21	Management of Other High Risk Patients <i>Seema A. Khan and Susan M. Gapstur</i>	291
Chapter 22	Chemoprevention: Clinical Aspects <i>Priya Rastogi, Shelly S. Lo, and Victor G. Vogel</i>	302

Section V *In Situ* Carcinoma

Chapter 23	Pathology and Biological Features of Premalignant Breast Disease <i>D. Craig Allred</i>	321
Chapter 24	Lobular Carcinoma <i>In Situ</i>: Biology and Pathology <i>Peter T. Simpson, Jorge S. Reis-Filho, and Sunil R. Lakhani</i>	333
Chapter 25	Lobular Carcinoma <i>In Situ</i>: Clinical Management <i>Kandice E. Kilbride and Lisa A. Newman</i>	341
Chapter 26	Ductal Carcinoma <i>In Situ</i> and Microinvasive Carcinoma <i>Monica Morrow and Jay R. Harris</i>	349

Section VI Pathology and Biological Markers of Invasive Breast Cancer

Chapter 27	Breast Cancer Genomics <i>Paul T. Spellman, Laura Heiser, and Joe W. Gray</i>	363
Chapter 28	Pathology of Invasive Breast Cancer <i>Deborah A. Dillon, Anthony J. Guidi, and Stuart J. Schnitt</i>	374
Chapter 29	Clinical Aspects of Estrogen and Progesterone Receptors <i>Rachel Schiff, C. Kent Osborne, and Suzanne A. W. Fuqua</i>	408
Chapter 30	ERBB2 Testing: Assessment of Status for Targeted Therapies <i>Melinda Epstein, Yanling Ma, and Michael F. Press</i>	431
Chapter 31	Prognostic and Predictive Markers <i>Jenny C. Chang and Susan G. Hilsenbeck</i>	443
Chapter 32	Gene Arrays, Prognosis, and Therapeutic Interventions <i>Lisa A. Carey and Charles M. Perou</i>	458
Chapter 33	Bone Marrow Micrometastases and Circulating Tumor Cells <i>Jeffrey B. Smerage and Daniel F. Hayes</i>	473