

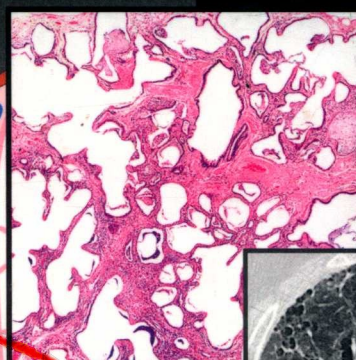
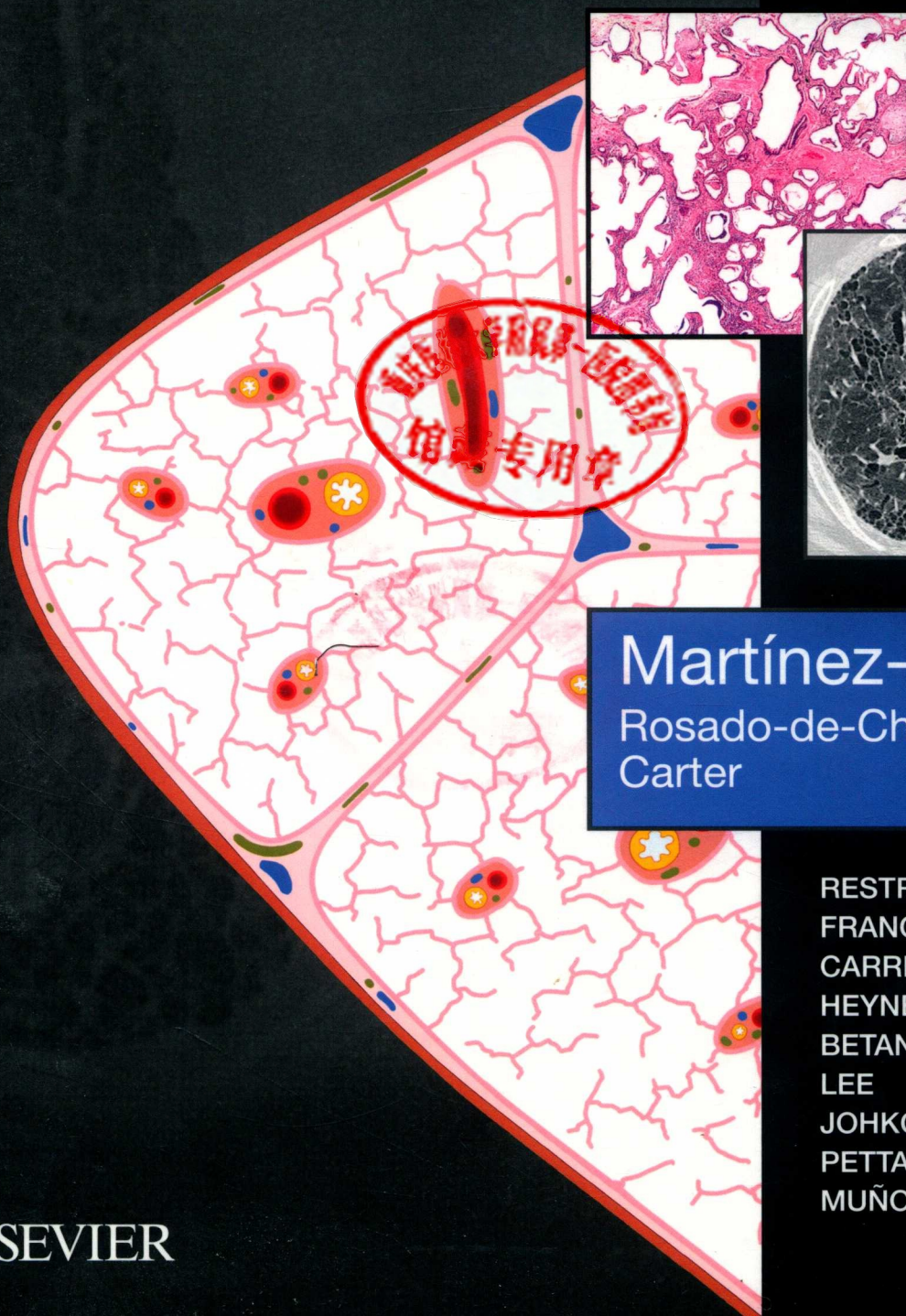
Get Full Access and More at

ExpertConsult.com

SPECIALTY IMAGING

# HRCT of the LUNG

SECOND EDITION



**Martínez-Jiménez**  
Rosado-de-Christenson  
Carter

RESTREPO  
FRANQUET  
CARRILLO-BAYONA  
HEYNEMAN  
BETANCOURT CUELLAR  
LEE  
JOHKOH  
PETTAVEL  
MUÑOZ

ELSEVIER

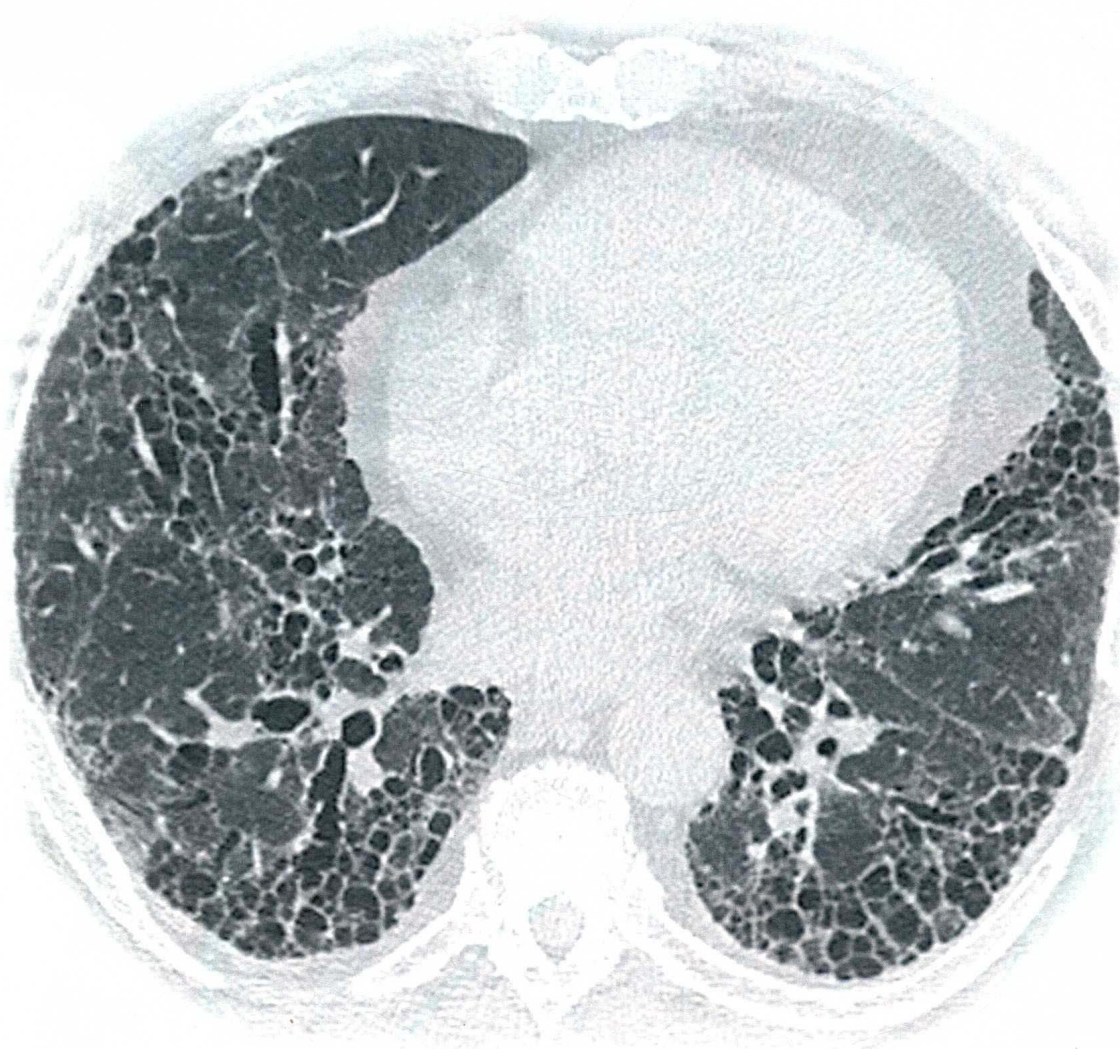


SPECIALTY IMAGING

# HRCT of the LUNG

SECOND EDITION

Martínez-Jiménez | Rosado-de-Christenson | Carter



Copyright © 2017 by Elsevier. All rights reserved.

No part of this publication may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopying, recording, or any information storage and retrieval system, without permission in writing from the publisher. Details on how to seek permission, further information about the Publisher's permissions policies and our arrangements with organizations such as the Copyright Clearance Center and the Copyright Licensing Agency, can be found at our website: [www.elsevier.com/permissions](http://www.elsevier.com/permissions).

This book and the individual contributions contained in it are protected under copyright by the Publisher (other than as may be noted herein).

## Notices

Knowledge and best practice in this field are constantly changing. As new research and experience broaden our understanding, changes in research methods, professional practices, or medical treatment may become necessary.

Practitioners and researchers must always rely on their own experience and knowledge in evaluating and using any information, methods, compounds, or experiments described herein. In using such information or methods they should be mindful of their own safety and the safety of others, including parties for whom they have a professional responsibility.

With respect to any drug or pharmaceutical products identified, readers are advised to check the most current information provided (i) on procedures featured or (ii) by the manufacturer of each product to be administered, to verify the recommended dose or formula, the method and duration of administration, and contraindications. It is the responsibility of practitioners, relying on their own experience and knowledge of their patients, to make diagnoses, to determine dosages and the best treatment for each individual patient, and to take all appropriate safety precautions.

To the fullest extent of the law, neither the Publisher nor the authors, contributors, or editors, assume any liability for any injury and/or damage to persons or property as a matter of products liability, negligence or otherwise, or from any use or operation of any methods, products, instructions, or ideas contained in the material herein.

## Publisher Cataloging-in-Publication Data

Names: Martínez-Jiménez, Santiago | Rosado de Christenson, Melissa L. | Carter, Brett W.

Title: Specialty imaging: HRCT of the lung / [edited by] Santiago Martínez-Jiménez, Melissa L. Rosado-de-Christenson, and Brett W. Carter.

Other titles: HRCT of the lung.

Description: Second edition. | Salt Lake City, UT : Elsevier, Inc., [2017] | Includes bibliographical references and index.

Identifiers: ISBN 978-0-323-52477-3

Subjects: LCSH: Lungs--Tomography--Handbooks, manuals, etc. | MESH: Lung Diseases--diagnostic imaging--Atlases. | Lung--diagnostic imaging--Atlases.

Classification: LCC RC734.T64 S634 2017 | NLM WF 600 | DDC 616.2'40754--dc23

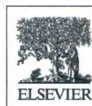
**International Standard Book Number:** 978-0-323-52477-3

Cover Designer: Tom M. Olson, BA

Cover Art: Laura C. Wissler, MA

Printed in Canada by Friesens, Altona, Manitoba, Canada

Last digit is the print number: 9 8 7 6 5 4 3 2 1



Working together  
to grow libraries in  
developing countries

[www.elsevier.com](http://www.elsevier.com) • [www.bookaid.org](http://www.bookaid.org)



# DEDICATIONS

*To “la mujer que yo quiero” and “esos locos bajitos,” with whom I could have been reading fantastic books or riding bikes for a hundred, or possibly a thousand, more hours.*

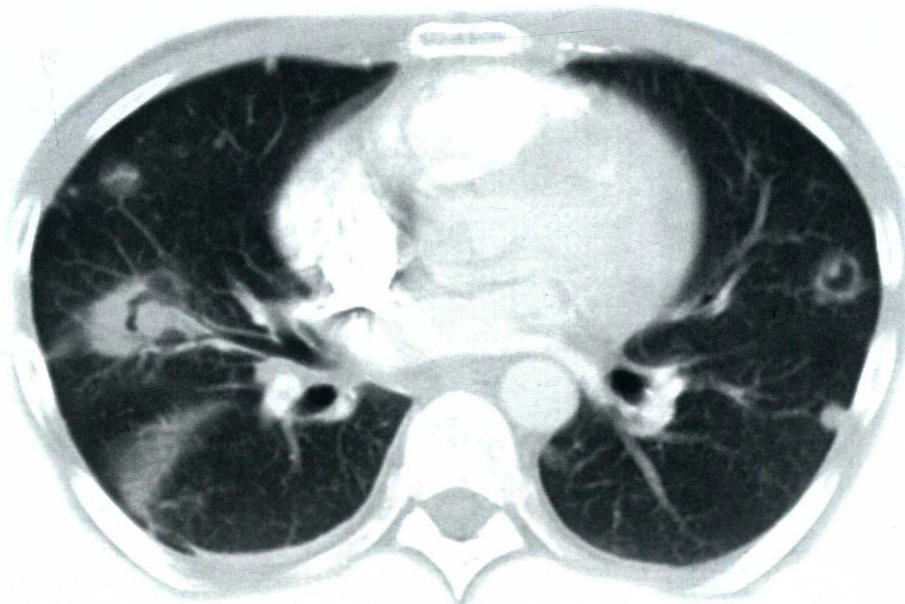
**SMJ**

*To my husband, Paul; daughters, Jennifer and Heather; and the rest of my family, for their unconditional love and immense support throughout the completion of this project. To my lead author, practice partner, and dear friend, Santiago Martínez-Jiménez, whose expert guidance, immense knowledge, and tireless efforts helped me expand my own knowledge of thoracic imaging and specifically of HRCT.*

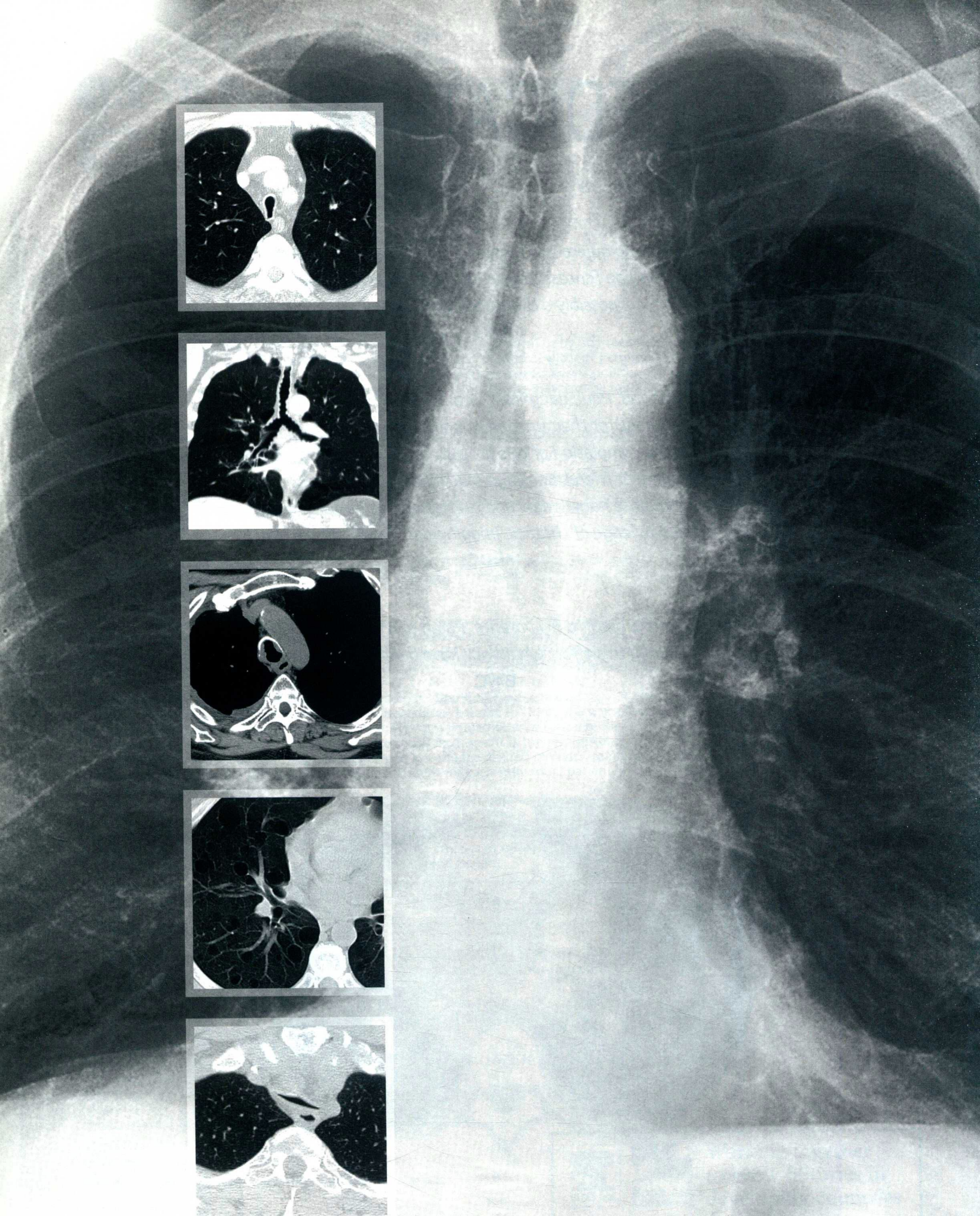
**MRDC**

*I dedicate this project to my parents, Ralph and Joy Carter, without whom this effort would not have been possible.*

**BWC**









# CONTRIBUTING AUTHORS

**Carlos S. Restrepo, MD**

Professor of Radiology  
Vice Chairman for Education  
Director of Cardio-Thoracic Radiology  
The University of Texas Health Science Center  
at San Antonio  
San Antonio, Texas

**Tomás Franquet, MD, PhD**

Chief of Thoracic Imaging  
Department of Radiology  
Hospital de Sant Pau  
Barcelona, Spain

**Jorge Alberto Carrillo-Bayona, MD**

Universidad Nacional de Colombia  
Hospital Universitario Mayor Mederi  
Hospital de San José  
Bogotá, Colombia

**Laura E. Heyneman, MD**

Professor  
Department of Radiology  
Duke University Medical Center  
Durham, North Carolina

**Sonia L. Betancourt Cuellar, MD**

Associate Professor  
Department of Diagnostic Radiology  
The University of Texas MD Anderson Cancer Center  
Houston, Texas

**Kyung Soo Lee, MD**

Professor  
Department of Radiology  
Samsung Medical Center  
Sungkyunkwan University School of Medicine  
Seoul, South Korea

**Takeshi Johkoh, MD, PhD**

Director  
Department of Radiology  
Kinki Central Hospital of Mutual Aid Association  
of Public School Teachers  
Itami, Japan

**Paul P. Pettavel, MD**

Anatomic Pathologist  
Saint Luke's Hospital  
University of Missouri-Kansas City  
Kansas City, Missouri

**Phillip A. Muñoz, MD**

Medical Director  
Golden Valley Memorial Hospital Laboratory  
Saint Luke's Pathology Associates  
Ameripath Kansas City  
Lenexa, Kansas

## *Additional Contributors*

**Gerald F. Abbott, MD, FACR**

**Florian J. Fintelmann, MD, FRCPC**

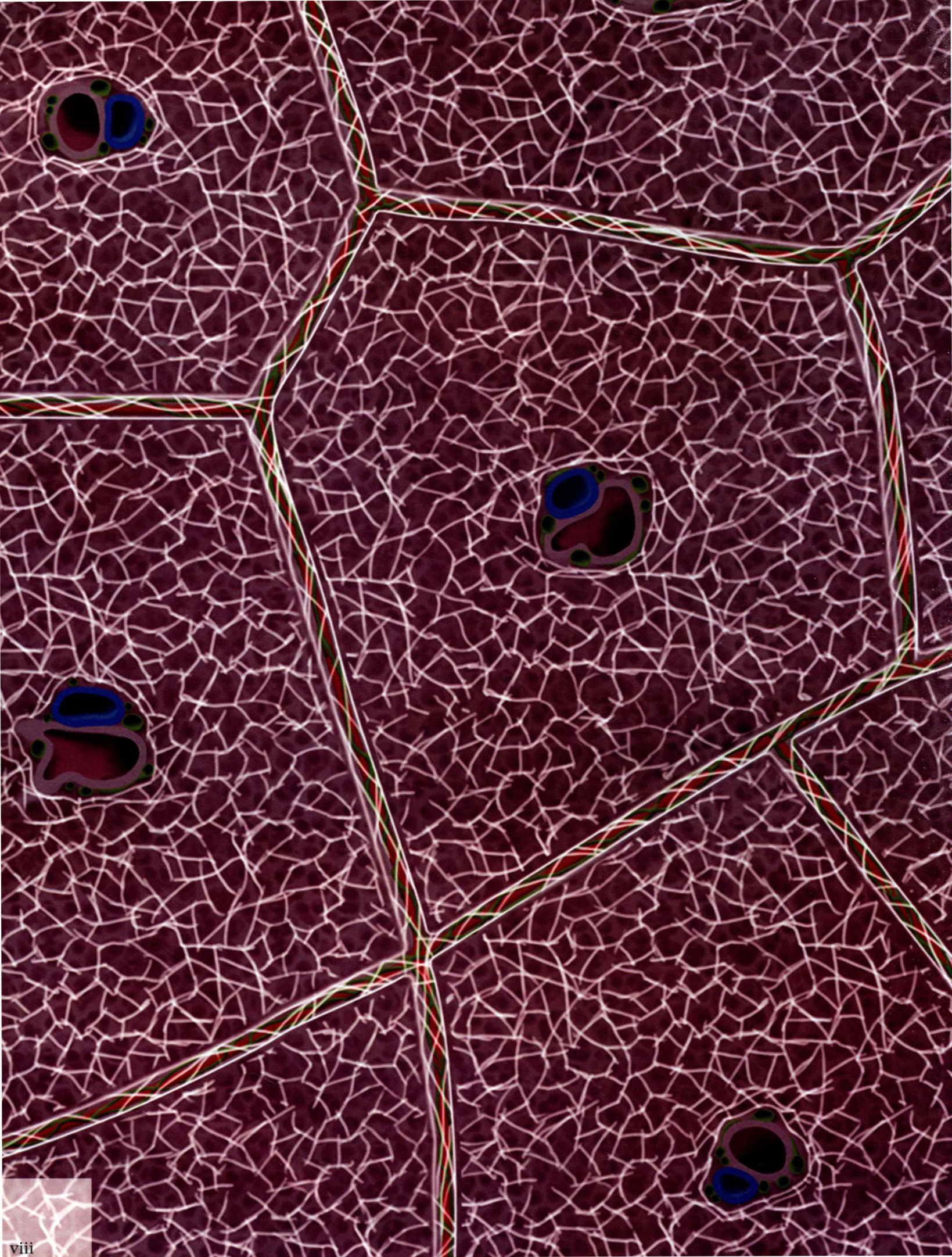
**Jud W. Gurney, MD, FACR**

**John P. Lichtenberger, III, MD, Maj, USAF, MC**

**Martha Huller Maier, MD**

**Helen T. Winer-Muram, MD**







# PREFACE

This book has meant a lot to me. First and foremost, it builds on the original work of Dr. Jud Gurney, who authored the first edition almost a decade ago. Unfortunately for all of us in the world of thoracic imaging, Dr. Gurney left us prematurely. However, his spirit and love for teaching live on in the pages of this book as we endeavored to build upon the wonderful foundation he established with the first edition, and for which we are immensely grateful.

Writing this book has been an incredible experience for me because it brings together important masters who have made major contributions to the field of thoracic imaging. Many of them are dear friends, which made the experience even more special.

A couple of decades ago, when I decided to pursue an academic career in thoracic radiology, HRCT was a trendy topic. I still remember how challenged and puzzled I felt when I faced the interstitial pneumonias. At one time I thought I would never master this knowledge, which further spurred my interest. Thereafter good luck never abandoned me. My first teacher, Tomás Franquet, welcomed me to his radiology department in Barcelona and taught me to navigate the world of HRCT. Subsequently, I learned from fantastic teachers both in Colombia and the USA, such as Jorge Carrillo, Santiago Restrepo, Sonia Betancourt, Lisa Diethelm, Page McAdams, Phil Goodman, and Laura Heyneman, some of whom graciously accepted my invitation to coauthor this book. They need no introduction, as their academic achievements speak for themselves. Finally, for the last decade I have worked with Melissa Rosado-de-Christenson, the most incredible woman, consummate professional, and innovator, who also requires no introduction.

Drs. Kyung Soo Lee and Takeshi Johkoh are also part of this book. Anyone who has trained in thoracic imaging has had the opportunity to learn from their seminal papers. In fact, Drs. Franquet, Lee, and Johkoh have contributed an immense body of scientific research to the world of radiology. Their decision to participate is a humbling testimony to their willingness to share their knowledge and expertise with the radiology community despite the immense time demands of their investigative work.

It is not an understatement that pathologic correlation is of utmost importance in understanding HRCT findings, perhaps more so than in any other area of radiology. Knowledge and recognition of basic pathologic concepts is critical for understating HRCT. Thus, histologic correlation was provided whenever possible. We were fortunate to partner with two outstanding pathologists at Saint Luke's Hospital of Kansas City who went above and beyond their duties to contribute the histologic material in this book: Paul Pettavel and Phil Muñoz. These are superb and talented pathologists for whom the demands of private practice have precluded academic recognition. However, they are without a doubt the best pathologists I have had the privilege of working with. Their knowledge, expert interpretation, and commitment to patient care are unparalleled in both private and academic pathology. Their valuable contributions perfectly complement the imaging content of this book.

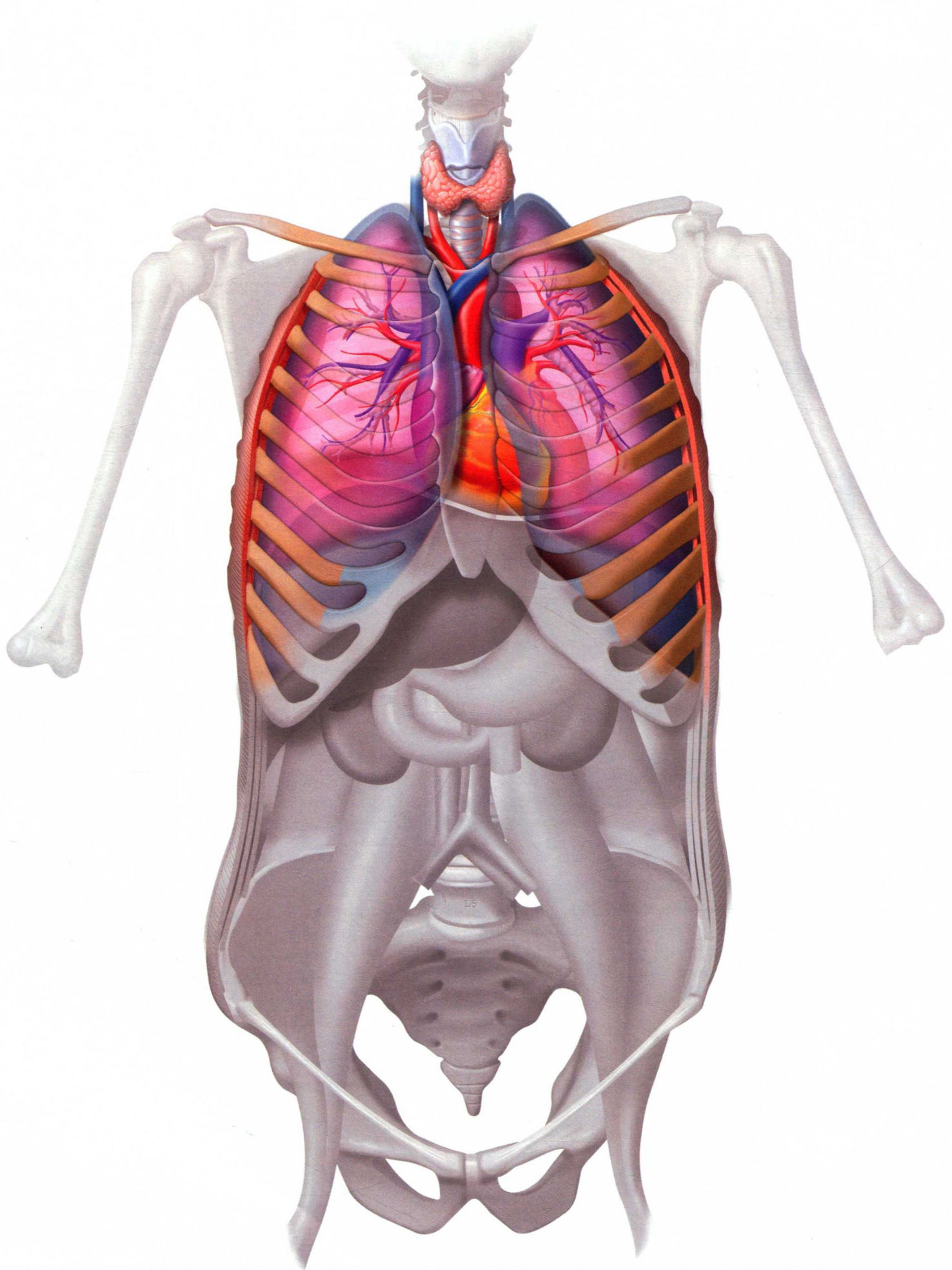
After several years of working on projects with Amirsys/Elsevier, Dr. Rosado-de-Christenson proposed that this book should have three lead authors, with Brett Carter as the third, and instrumental, partner. This resulted in a comprehensive and systematic review of the work submitted by all the authors, which far exceeded that of the books we previously published. This meant much more time spent reviewing, editing, and correcting, and made this the most "peer-reviewed" and exhaustively scrutinized of all our books. I personally think that the extra effort, which at times felt excessive, substantially elevated the book's quality.

Finally, I want to specially thank Amirsys/Elsevier for allowing me to lead this project. I want to particularly thank Matthew Hoecherl, whose editorial assistance was superb. I greatly enjoyed working with the entire team, and this incredible experience has made it difficult, if not impossible, to even consider the possibility of working with other publishers.

## **Santiago Martínez-Jiménez, MD**

Department of Radiology  
Saint Luke's Hospital of Kansas City  
Professor of Radiology  
University of Missouri-Kansas City School of Medicine  
Kansas City, Missouri







# ACKNOWLEDGMENTS

## **Text Editors**

Arthur G. Gelsinger, MA  
Nina I. Bennett, BA  
Terry W. Ferrell, MS  
Lisa A. Gervais, BS  
Karen E. Concannon, MD, PhD  
Meggy Morin, BA

## **Image Editors**

Jeffrey J. Marmorstone, BS  
Lisa A. M. Steadman, BS

## **Illustrations**

Lane R. Bennion, MS  
Richard Coombs, MS  
Laura C. Wissler MA

## **Art Direction and Design**

Tom M. Olson, BA  
Laura C. Wissler, MA

## **Lead Editor**

Matt W. Hoecherl, BS

## **Production Coordinators**

Rebecca L. Bluth, BA  
Angela M.G. Terry, BA  
Emily C. Fassett, BA

**ELSEVIER**







# SECTIONS

## **SECTION 1:**

Fundamentals of HRCT

## **SECTION 2:**

Pathological Patterns of Injury

## **SECTION 3:**

Large Airways Disease

## **SECTION 4:**

Small Airways Disease

## **SECTION 5:**

Infection

## **SECTION 6:**

Pneumoconiosis

## **SECTION 7:**

Neoplasms

## **SECTION 8:**

Interstitial Pneumonias

## **SECTION 9:**

Autoimmune Diseases

## **SECTION 10:**

Vascular Disease

## **SECTION 11:**

Inhalational, Inflammatory, Metabolic, and Post Treatment

## **SECTION 12:**

Congenital



# TABLE OF CONTENTS

## SECTION 1: FUNDAMENTALS OF HRCT

- 4 **Overview of HRCT**  
*Santiago Martínez-Jiménez, MD*
- 8 **Approach to HRCT Interpretation**  
*Santiago Martínez-Jiménez, MD*

## ANATOMY

- 14 **Secondary Pulmonary Lobule**  
*Melissa L. Rosado-de-Christenson, MD, FACP*
- 18 **Gravitational Changes (Dependent Atelectasis)**  
*Santiago Martínez-Jiménez, MD*
- 20 **Age-Related (Senescent) Changes**  
*Melissa L. Rosado-de-Christenson, MD, FACP*
- 24 **Normal Inspiration and Expiration**  
*Melissa L. Rosado-de-Christenson, MD, FACP*

## TERMINOLOGY AND SIGNS

- 28 **Micronodules**  
*Santiago Martínez-Jiménez, MD*
- 29 **Acinar Nodules**  
*Melissa L. Rosado-de-Christenson, MD, FACP*
- 30 **Tree-in-Bud Opacities**  
*Tomás Franquet, MD, PhD*
- 31 **Ground-Glass Attenuation**  
*Brett W. Carter, MD*
- 32 **Crazy-Paving Pattern**  
*Tomás Franquet, MD, PhD*
- 33 **Mosaic Attenuation Pattern and Air-Trapping**  
*Santiago Martínez-Jiménez, MD*
- 34 **Head Cheese Sign**  
*Brett W. Carter, MD*
- 35 **Signet Ring Sign**  
*Santiago Martínez-Jiménez, MD*
- 36 **Halo Sign**  
*Laura E. Heyneman, MD and Santiago Martínez-Jiménez, MD*
- 37 **Reversed Halo Sign**  
*Santiago Martínez-Jiménez, MD*
- 38 **Finger-in-Glove Sign**  
*Santiago Martínez-Jiménez, MD*
- 39 **Honeycombing**  
*Santiago Martínez-Jiménez, MD*
- 40 **Cystic Lung Disease**  
*Melissa L. Rosado-de-Christenson, MD, FACP*
- 41 **Flame-Shaped Nodules**  
*Brett W. Carter, MD*

## DISTRIBUTION

- 42 **Peribronchovascular**  
*Santiago Martínez-Jiménez, MD and Paul P. Pettavel, MD*
- 46 **Centrilobular**  
*Santiago Martínez-Jiménez, MD and Paul P. Pettavel, MD*
- 50 **Perilymphatic**  
*Kyung Soo Lee, MD*
- 54 **Random**  
*Brett W. Carter, MD*
- 55 **Peripheral**  
*Brett W. Carter, MD*

## SECTION 2: PATHOLOGICAL PATTERNS OF INJURY

- 58 **Approach to Pathological Patterns of Injury**  
*Santiago Martínez-Jiménez, MD and Phillip A. Muñoz, MD*
- 62 **Diffuse Alveolar Damage**  
*Santiago Martínez-Jiménez, MD and Paul P. Pettavel, MD*
- 66 **Diffuse Alveolar Hemorrhage With Capillaritis**  
*Santiago Martínez-Jiménez, MD and Paul P. Pettavel, MD*
- 70 **Organizing Pneumonia**  
*Santiago Martínez-Jiménez, MD and Paul P. Pettavel, MD*
- 74 **Constrictive Bronchiolitis**  
*Tomás Franquet, MD, PhD*

## SECTION 3: LARGE AIRWAYS DISEASE

- 80 **Approach to Large Airways Disease**  
*Melissa L. Rosado-de-Christenson, MD, FACP*
- 82 **Bronchiectasis**  
*Laura E. Heyneman, MD and Jud W. Gurney, MD, FACP*
- 86 **Allergic Bronchopulmonary Aspergillosis**  
*Melissa L. Rosado-de-Christenson, MD, FACP*
- 90 **Williams-Campbell Syndrome**  
*Sonia L. Betancourt Cuellar, MD*
- 92 **Mounier-Kuhn Syndrome**  
*Carlos S. Restrepo, MD*
- 94 **Bronchocentric Granulomatosis**  
*Jorge Alberto Carrillo-Bayona, MD*

## SECTION 4: SMALL AIRWAYS DISEASE

- 100 **Approach to Small Airways Disease**  
*Brett W. Carter, MD*
- 102 **Infectious Bronchiolitis**  
*Laura E. Heyneman, MD*
- 106 **Diffuse Aspiration Bronchiolitis**  
*Laura E. Heyneman, MD*
- 110 **Respiratory Bronchiolitis**  
*Jorge Alberto Carrillo-Bayona, MD*



# TABLE OF CONTENTS

- 112 **Follicular Bronchiolitis**  
*Jorge Alberto Carrillo-Bayona, MD*
- 116 **Hypersensitivity Pneumonitis**  
*Kyung Soo Lee, MD*
- 122 **Diffuse Panbronchiolitis**  
*Kyung Soo Lee, MD*
- 124 **Idiopathic Constrictive Bronchiolitis**  
*Melissa L. Rosado-de-Christenson, MD, FACP*
- 128 **Swyer-James-MacLeod Syndrome**  
*Laura E. Heyneman, MD*
- 132 **Bronchiolitis Obliterans Syndrome**  
*Carlos S. Restrepo, MD*
- 136 **Diffuse Idiopathic Pulmonary Neuroendocrine Cell Hyperplasia (DIPNECH)**  
*Melissa L. Rosado-de-Christenson, MD, FACP*

## SECTION 5: INFECTION

- 142 **Approach to Infection**  
*Melissa L. Rosado-de-Christenson, MD, FACP*
- 146 **Bacterial Pneumonia**  
*Tomás Franquet, MD, PhD*
- 150 **Parasitic Infection**  
*Tomás Franquet, MD, PhD*
- 156 **Viral Pneumonia**  
*Tomás Franquet, MD, PhD*
- 160 **Invasive Aspergillosis**  
*Tomás Franquet, MD, PhD*
- 164 **Pneumocystis Pneumonia**  
*Jorge Alberto Carrillo-Bayona, MD*
- 168 **Tuberculosis**  
*Kyung Soo Lee, MD*
- 174 **Nontuberculous Mycobacterial Infection**  
*Kyung Soo Lee, MD*

## SECTION 6: PNEUMOCONIOSIS

- 182 **Approach to Pneumoconiosis**  
*Melissa L. Rosado-de-Christenson, MD, FACP*
- 184 **Silicosis and Coal Worker's Pneumoconiosis**  
*Brett W. Carter, MD*
- 188 **Asbestosis**  
*Carlos S. Restrepo, MD and Helen T. Winer-Muram, MD*
- 194 **Berylliosis**  
*Sonia L. Betancourt Cuellar, MD*
- 198 **Talcosis**  
*Carlos S. Restrepo, MD and Jud W. Gurney, MD, FACP*
- 202 **Hard-Metal Pneumoconiosis**  
*Kyung Soo Lee, MD*

## SECTION 7: NEOPLASMS

- 206 **Approach to Neoplasms**  
*Brett W. Carter, MD*
- 210 **Invasive Mucinous Adenocarcinoma (Diffuse)**  
*Kyung Soo Lee, MD*
- 214 **Lymphangitic Carcinomatosis**  
*Sonia L. Betancourt Cuellar, MD*
- 218 **Hematogenous Metastases**  
*John P. Lichtenberger, III, MD, Maj, USAF, MC and Brett W. Carter, MD*

- 222 **Endovascular Metastases and Tumor Emboli**  
*Brett W. Carter, MD, Florian J. Fintelmann, MD, FRCPC, and Gerald F. Abbott, MD, FACP*
- 226 **Kaposi Sarcoma**  
*Santiago Martínez-Jiménez, MD, Carlos S. Restrepo, MD, and Brett W. Carter, MD*
- 230 **Lymphangioleiomyomatosis**  
*Melissa L. Rosado-de-Christenson, MD, FACP and Takeshi Johkoh, MD, PhD*
- 234 **Reactive Lymphoproliferative Disorders**  
*Jorge Alberto Carrillo-Bayona, MD*
- 240 **Neoplastic Lymphoproliferative Disorders**  
*Jorge Alberto Carrillo-Bayona, MD*

## SECTION 8: INTERSTITIAL PNEUMONIAS

- 248 **Approach to Interstitial Pneumonias**  
*Melissa L. Rosado-de-Christenson, MD, FACP*
- 252 **Idiopathic Pulmonary Fibrosis**  
*Takeshi Johkoh, MD, PhD*
- 258 **Idiopathic Nonspecific Interstitial Pneumonia**  
*Kyung Soo Lee, MD*
- 262 **Cryptogenic Organizing Pneumonia**  
*Jorge Alberto Carrillo-Bayona, MD*
- 266 **Acute Exacerbation of Interstitial Lung Disease**  
*Takeshi Johkoh, MD, PhD*
- 270 **Acute Interstitial Pneumonia**  
*Carlos S. Restrepo, MD and Jud W. Gurney, MD, FACP*
- 274 **Idiopathic Lymphoid Interstitial Pneumonia**  
*Takeshi Johkoh, MD, PhD*
- 278 **Pleuropulmonary Fibroelastosis**  
*Takeshi Johkoh, MD, PhD*
- 282 **Airway-Centered Interstitial Fibrosis**  
*Tomás Franquet, MD, PhD*
- 286 **Interstitial Pneumonia With Autoimmune Features (IPAF)**  
*Takeshi Johkoh, MD, PhD*
- 292 **Approach to Smoking-Related Interstitial Lung Diseases**  
*Melissa L. Rosado-de-Christenson, MD, FACP*
- 296 **Respiratory Bronchiolitis-Interstitial Lung Disease**  
*Kyung Soo Lee, MD*
- 298 **Desquamative Interstitial Pneumonia**  
*Jorge Alberto Carrillo-Bayona, MD*
- 302 **Combined Pulmonary Fibrosis and Emphysema**  
*Carlos S. Restrepo, MD*

## SECTION 9: AUTOIMMUNE DISEASES

- 308 **Approach to Connective Tissue Disease-Associated Interstitial Lung Disease**  
*Carlos S. Restrepo, MD*
- 312 **Rheumatoid Arthritis**  
*Sonia L. Betancourt Cuellar, MD*
- 316 **Progressive Systemic Sclerosis**  
*Brett W. Carter, MD*
- 320 **Dermatomyositis/Polymyositis**  
*Carlos S. Restrepo, MD*
- 324 **Sjögren Syndrome**  
*Sonia L. Betancourt Cuellar, MD*



# TABLE OF CONTENTS

- 330 **Mixed Connective Tissue Disease**  
*Laura E. Heyneman, MD*
- 332 **Systemic Lupus Erythematosus**  
*Laura E. Heyneman, MD*
- 338 **Granulomatosis With Polyangiitis (GPA)**  
*Kyung Soo Lee, MD*
- 344 **Eosinophilic Granulomatosis With Polyangiitis**  
*Jorge Alberto Carrillo-Bayona, MD*
- 348 **Microscopic Polyangiitis**  
*Jorge Alberto Carrillo-Bayona, MD*
- 350 **Ankylosing Spondylitis**  
*Tomás Franquet, MD, PhD and Martha Huller Maier, MD*
- 354 **Inflammatory Bowel Disease**  
*Sonia L. Betancourt Cuellar, MD*

## SECTION 10: VASCULAR DISEASE

- 360 **Approach to Vascular Disease**  
*Brett W. Carter, MD*
- 362 **Pulmonary Edema**  
*Melissa L. Rosado-de-Christenson, MD, FACP*
- 368 **Hepatopulmonary Syndrome**  
*Kyung Soo Lee, MD*
- 370 **Pulmonary Hypertension**  
*Tomás Franquet, MD, PhD and Jud W. Gurney, MD, FACP*
- 374 **Pulmonary Venoocclusive Disease**  
*Kyung Soo Lee, MD*
- 376 **Pulmonary Capillary Hemangiomatosis**  
*Laura E. Heyneman, MD*
- 378 **Excipient Lung Disease (Talc/Cellulose Granulomatosis)**  
*Santiago Martínez-Jiménez, MD*

## SECTION 11: INHALATIONAL, INFLAMMATORY, METABOLIC, AND POST TREATMENT

- 386 **Approach to Inhalational, Inflammatory, Metabolic, and Post Treatment**  
*Brett W. Carter, MD*

## ASPIRATION/INHALATION

- 392 **Spectrum of Aspiration-Related Disorders**  
*Tomás Franquet, MD, PhD and Gerald F. Abbott, MD, FACP*
- 396 **Lipoid Pneumonia**  
*Sonia L. Betancourt Cuellar, MD*
- 400 **Inhalational Injury**  
*Sonia L. Betancourt Cuellar, MD*

## INFLAMMATORY

- 404 **Sarcoidosis**  
*Sonia L. Betancourt Cuellar, MD*
- 410 **Histiocytic Disorders**  
*Jorge Alberto Carrillo-Bayona, MD*
- 416 **Eosinophilic Disorders**  
*Tomás Franquet, MD, PhD*

## METABOLIC OR DEGENERATIVE

- 420 **Amyloidosis**  
*Laura E. Heyneman, MD*
- 424 **Light-Chain Deposition Disease**  
*Takeshi Johkoh, MD, PhD*
- 426 **Pulmonary Alveolar Proteinosis**  
*Jorge Alberto Carrillo-Bayona, MD*
- 432 **Metastatic Pulmonary Calcification**  
*Tomás Franquet, MD, PhD and Jud W. Gurney, MD, FACP*
- 436 **Diffuse Pulmonary Ossification**  
*Carlos S. Restrepo, MD*
- 438 **Emphysema**  
*Laura E. Heyneman, MD*
- 442 **Idiopathic Pulmonary Hemosiderosis**  
*Laura E. Heyneman, MD*

## POST TREATMENT

- 444 **Radiation-Induced Lung Disease**  
*Sonia L. Betancourt Cuellar, MD*
- 450 **Drug-Induced Lung Disease**  
*Sonia L. Betancourt Cuellar, MD*

## SECTION 12: CONGENITAL

- 456 **Approach to Congenital**  
*Brett W. Carter, MD*
- 462 **Familial Idiopathic Pulmonary Fibrosis**  
*Carlos S. Restrepo, MD*
- 464 **Birt-Hogg-Dubé Syndrome**  
*Melissa L. Rosado-de-Christenson, MD, FACP*
- 466 **Hermansky-Pudlak Syndrome**  
*Carlos S. Restrepo, MD*
- 468 **Tuberous Sclerosis**  
*Carlos S. Restrepo, MD*
- 472 **Neurofibromatosis**  
*Sonia L. Betancourt Cuellar, MD*
- 474 **Alveolar Microlithiasis**  
*Jorge Alberto Carrillo-Bayona, MD*
- 476  **$\alpha$ -1 Antitrypsin Deficiency**  
*Jorge Alberto Carrillo-Bayona, MD*
- 478 **Primary Ciliary Dyskinesia**  
*Melissa L. Rosado-de-Christenson, MD, FACP*
- 482 **Primary Immunodeficiencies**  
*Tomás Franquet, MD, PhD*
- 486 **Chronic Granulomatous Disease**  
*Carlos S. Restrepo, MD*
- 488 **Cystic Fibrosis**  
*Laura E. Heyneman, MD and Gerald F. Abbott, MD, FACP*
- 492 **Childhood Interstitial Lung Disease (chILD)**  
*Carlos S. Restrepo, MD*



SPECIALTY IMAGING

# HRCT of the LUNG

SECOND EDITION

Martínez-Jiménez | Rosado-de-Christenson | Carter

