

Eighth Edition

Shields'

GENERAL THORACIC SURGERY

VOLUME ONE



JOSEPH LOCICERO, III
RICHARD H. FEINS
YOLONDA L. COLSON
GAETANO ROCCO

 Wolters Kluwer

Volume One & Two

Shields'
**GENERAL THORACIC
SURGERY**
8th Edition

EDITED BY

Joseph LoCicero III, MD

Professor Emeritus of Surgery
SUNY Downstate
Brooklyn, New York
Physician Consultant
Mobile County Health Department
Mobile, Alabama

Richard H. Feins, MD

Professor of Surgery
Division of Cardiothoracic Surgery
University of North Carolina at Chapel Hill
Chapel Hill, North Carolina

Yolonda L. Colson, MD, PhD

Michael A. Bell Distinguished Chair in Healthcare Innovation
Professor of Surgery
Harvard Medical School
Brigham and Women's Hospital
Boston, Massachusetts

Gaetano Rocco, MD, FRCSEd

Professor
Chief, Division of Thoracic Surgery
Istituto Nazionale Tumori, IRCCS, Pascale Foundation
Naples, Italy



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

Acquisitions Editor: Keith Donnellan
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Prepress Vendor: Aptara, Inc.

8th edition

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9 8 7 6 5 4 3 2 1

Printed in The United States of America

Library of Congress Cataloging-in-Publication Data

Names: LoCicero, Joseph, III, 1948- editor. | Feins, Richard H., editor. | Colson, Yolonda L., editor. | Rocco, Gaetano, MD, editor.

Title: Shields' general thoracic surgery / [edited by] Joseph LoCicero III, Richard H. Feins, Yolonda L. Colson, Gaetano Rocco.

Other titles: General thoracic surgery.

Description: 8th edition. | Philadelphia : Wolters Kluwer, [2019] | Preceded by General thoracic surgery / edited by Thomas W. Shields... [et al.]. 7th ed. c2009. | Includes bibliographical references and index.

Identifiers: LCCN 2017051947 | ISBN 9781975102241

Subjects: | MESH: Thoracic Surgical Procedures | Thoracic Neoplasms—surgery

Classification: LCC RD536 | NLM WF 980 | DDC 617.5/4059—dc23

LC record available at <https://lccn.loc.gov/2017051947>

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Dedication to Dr. Thomas W. Shields

This 8th edition of General Thoracic Surgery marks the first time Dr. Shields has not been an active member of the editorial directors, yet his influence on the text remains strong. His lifelong interest in lung cancer began in 1951 with a fellowship at the Palmer Memorial Hospital, the cancer building that was part of Deaconess Hospital, now Beth Israel Deaconess Medical Center. His experiences with the thoracic surgeon, dynamic and controversial Richard Overholt inspired him to begin a lifelong study into thoracic lymphatic drainage and lesser pulmonary resections.

He traveled the globe gathering data from leading centers making strong bonds with many international colleagues. Using this wealth of knowledge, he compiled the first edition of General Thoracic Surgery published in 1972, updating it every few years.

Dr. Shields was a legend to the surgical students and residents of Northwestern University up to the time of his death in 2010. His devotion to clear communication of thought made him a tough taskmaster. His advocacy of evidence-based practice often made him a lightning rod among his colleagues. We hope that this edition continues the tradition of enhancing our understanding and practice of thoracic surgery through assimilation of knowledge and expertise from around the world.

—JLIII

Dedication to Dr. Carolyn E. Reed, MD

This 8th edition of General Thoracic Surgery is dedicated in part to our friend and colleague, Dr. Carolyn E. Reed who was an editor of the 7th edition and was working on this edition until her untimely death.

Dr. Reed was an outstanding clinician, teacher, and researcher. Her impact on the field of thoracic surgery was extraordinary. While maintaining a busy clinical practice at the Medical University of South Carolina, she made a major impact on our knowledge of diseases of the chest and how to treat them. She was an NIH-funded researcher and investigator on numerous important national clinical trials. She served our specialty as the first woman chair of the American Board of Thoracic Surgery and the first woman president of the Southern Thoracic Surgical Association. Also, she served as vice-chair of the Residency Review Committee for Thoracic Surgery, treasurer of the Society of Thoracic Surgeons, treasurer of Women in Thoracic Surgery, council member of the American Association for Thoracic Surgery, board member of the Joint Council for Thoracic Surgical Education and the Thoracic Surgery Foundation for Research and Education. Posthumously, she was unanimously elected the first woman president of the Society of Thoracic Surgeons.

After her love for providing care to her patients, Dr. Reed's passion was imparting knowledge to her students and residents. It is our hope that this edition of General Thoracic Surgery will make a fitting completion to her obligations, which were such a large part of her life and that those who use it will continue to experience the wonder of being her student.

—RHF

To my family and to all succeeding generations of knowledge-seeking, innovative healers around the world to whom we entrust our future health.

—JLIII

To the men and women of Thoracic Surgery who have dedicated their lives to the treatment of diseases of the chest. It is a specialty that has embraced the research and new technologies required to serve our patients at the highest level and the spirit of professionalism that is the envy of all of medicine. And to the teachers of Thoracic Surgery who devote themselves day in and day out to ensuring that there will always be outstanding chest surgeons.

—RHF

To Gina and Raffaele, sempiternal source of energy and inspiration. Amor gignit amorem.

—GR

To my father for teaching me to dream big, my mother for making hard work and fortitude part of my DNA, my patients for giving me purpose, my collaborator Mark Grinstaff for the gift of creativity and friendship, my husband Gray for providing unlimited love and support and believing in the impossible every day, my two daughters, Karinne and Azuri, and all of my trainees for opening my eyes to the amazing potential of the next generation, and my special team that keeps everything running and makes my work enjoyable.

—YLC

Contributing Authors

Ghulam Abbas, MD, MHCM, FACS

Chief, Division of Thoracic Surgery
West Virginia University School of Medicine
Morgantown, West Virginia

Jay Acharya, MD

Assistant Professor
Department of Radiology
Keck Medicine of USC
Los Angeles, California

Usman Ahmad, MD

Assistant Professor of Surgery
Staff Surgeon, Thoracic Surgery
Cleveland Clinic
Cleveland, Ohio

Marco Alifano, MD, PhD

Full Professor
Department of Thoracic Surgery
Paris Descartes University
Paris Center University Hospital
Paris, France

Mark S. Allen, MD

Professor of Surgery
Division of General Thoracic Surgery
Mayo Clinic
Rochester, Minnesota

Nasser K. Altorki, MB, BCh

Professor of Thoracic Surgery
Department of Cardiothoracic Surgery
Weill Cornell Medical College
New York Presbyterian Hospital
New York, New York

Isabel Alvarado-Cabrero, MD, PhD

Department of Pathology
Mexican Oncology Hospital, IMSS
Mexico City, Mexico

Rafael Andrade, MD, MHA

Associate Professor

Chief, Division of Thoracic and Foregut Surgery

University of Minnesota

Minneapolis, Minnesota

Marco Anile, MD, PhD

Associate Professor

Department of Thoracic Surgery

Sapienza University of Rome

Rome, Italy

Beatrice Aramini, MD, PhD

Assistant Professor

Department of Medical and Surgical Sciences for Children and Adults

Division of Thoracic Surgery

University of Modena and Reggio Emilia

Modena, Italy

Saeed Arefanian, MD

General Surgery Resident

Department of Surgery

Washington University in St. Louis

St. Louis, Missouri

Amrita K. Arneja, MD

Neuroradiology Fellow

Department of Radiology

Mount Sinai Health System

New York, New York

Oscar Arrieta-Rodriguez, MD, MSc

Department Coordinator

Thoracic Oncology Unit

Instituto Nacional de Cancerología

México City, México

Hisao Asamura, MD

Professor of Surgery

Chief

Division of Thoracic Surgery

Keio University School of Medicine

Tokyo, Japan

Hugh G. Auchincloss, MD, MPH

Division of Thoracic Surgery

Massachusetts General Hospital

Boston, Massachusetts

Diego Avella Patino, MD

Assistant Professor of Surgery

Division of Cardiac and Thoracic Surgery

University of Missouri
Columbia, Missouri

Lea Azour, MD

Assistant Professor
Department of Radiology
NYU Langone Medical Center
New York, New York

Carl L. Backer, MD

Professor of Surgery
Northwestern University Feinberg School of Medicine
Division Head
Cardiovascular-Thoracic Surgery
Ann & Robert H. Lurie Children's Hospital of Chicago
Chicago, Illinois

Patrick Bagan, MD

Head of Department
Unit of Thoracic and Vascular Surgery
Victor Dupouy Hospital
Argenteuil, France

Erin E. Bailey, MD

General Surgeon
Department of Surgery
Graham Health System
Canton, Illinois

Brian P. Barrick, MD, DDS

Professor
Department of Anesthesiology
University of North Carolina at Chapel Hill
Chapel Hill, North Carolina

Thomas L. Bauer II, MD

Associate Professor of Surgery
Hackensack Meridian School of Medicine at Seton Hall University
South Orange, New Jersey
Hackensack Meridian Health Jersey Shore University Medical Center
Neptune, New Jersey

Egidio Beretta, MD, PhD

Department of Medicine and Surgery
University of Milano-Bicocca
Milan, Italy

Edward J. Bergeron, MD

Munson Medical Center
Traverse City, Michigan

Laureline Berteloot, MD

Radiologist

Department of Pediatric Imaging
Necker-Enfants Malades Hospital
Paris, France

Sanjeev Bhalla, MD

Section Chief

Professor of Radiology
Cardiothoracic Imaging
Mallinckrodt Institute of Radiology
Washington University
St. Louis, Missouri

Shanda H. Blackmon, MD, MPH

Associate Professor

Department of Surgery
Division of Thoracic Surgery
Mayo Clinic
Rochester, Minnesota

Eugene H. Blackstone, MD

Head of Clinical Investigations

The Sydell and Arnold Miller Family Heart & Vascular Institute
Staff member

Department of Thoracic and Cardiovascular Surgery
Quantitative Health Sciences and Transplant Center
Cleveland Clinic
Cleveland, Ohio

Antonio Bobbio, MD, PhD

Praticien Hospitalier

Service de Chirurgie Thoracique
Hôpital Cochin, APHP
Paris, France

Daniel J. Boffa, MD

Associate Professor

Department of Surgery
Yale School of Medicine
New Haven, Connecticut

Timothy Brand, MD

Department of Cardiothoracic Surgery
University of North Carolina at Chapel Hill
Chapel Hill, North Carolina

Alejandro C. Bribriesco, MD

Associate Staff

Department of Thoracic and Cardiovascular Surgery
Cleveland Clinic
Cleveland, Ohio

Lisa M. Brown, MD, MAS

Assistant Professor
Division of Cardiothoracic Surgery
UC Davis Health
Sacramento, California

Andrew Brownlee, MD

Fellow
Section of Cardiothoracic Surgery
University of Chicago Medicine
Chicago, Illinois

Alessandro Brunelli, MD

Consultant Thoracic Surgeon
Honorary Clinical Associate Professor
Department of Thoracic Surgery
St. James's University Hospital
Leeds, United Kingdom

Raphael Bueno, MD

Chief
Division of Thoracic Surgery
Brigham and Women's Hospital
Boston, Massachusetts

Timothy F. Burns, MD, PhD

Assistant Professor
Department of Medicine
Division of Hematology Oncology
University of Pittsburgh School of Medicine
Pittsburgh, Pennsylvania

Peter H. Burri, MD

Professor Emeritus of Anatomy
Institute of Anatomy
University of Bern
Bern, Switzerland

Bryan M. Burt, MD

Associate Professor of Surgery
Department of Surgery
Baylor College of Medicine
Houston, Texas

Shamus R. Carr, MD, FACS

Assistant Professor

Department of Surgery
Division of Thoracic Surgery
University of Maryland School of Medicine
Baltimore, Maryland

Philip Carrott, MD

Assistant Professor
Section of Thoracic Surgery
University of Michigan
Ann Arbor, Michigan

Ernest G. Chan, MD

Department of Cardiothoracic Surgery
University of Pittsburgh Medical Center
Pittsburgh, Pennsylvania

Patrick G. Chan, MD

Department of Cardiothoracic Surgery
University of Pittsburgh Medical center
Pittsburgh, Pennsylvania

John Holt Chaney, MD

Attending Physician
Lexington, Kentucky

Andrew C. Chang, MD

John Alexander Distinguished Professor
Head of the Section of Thoracic Surgery
University of Michigan
Ann Arbor, Michigan

Stephanie Chang, MD

Cardiothoracic Surgery Fellow
Department of Surgery
Washington University in St. Louis
St. Louis, Missouri

Delphine L. Chen, MD

Associate Professor of Radiology, Medicine, and Biomedical Engineering
Mallinckrodt Institute of Radiology
Washington University School of Medicine
St. Louis, Missouri

Aaron M. Cheng, MD

Associate Professor
Department of Surgery
Division of Cardiothoracic Surgery
Co-Director
UWMC Cardiothoracic ICU
University of Washington

Seattle, Washington

Mala R. Chinoy, PhD, MBA

Professor

Department of Biochemistry and Molecular Biology

Penn State College of Medicine

Hershey, Pennsylvania

Priscilla Chiu, MD, PhD

Assistant Professor

Department of Surgery

University of Toronto

Staff Surgeon

Division of General and Thoracic Surgery

The Hospital for Sick Children

Toronto, Ontario, Canada

Cliff K. C. Choong, MBBS, FRCS, FRACS

Associate Professor in Surgery

Consultant Thoracic Surgeon

Monash University School of Rural Health

Latrobe Regional Hospital

Victoria, Australia

Anna Maria Ciccone, MD, PhD

Assistant Professor

Division of Thoracic Surgery

Sapienza University of Rome

Rome, Italy

Graham A. Colditz, MD, DrPH

Niess-Gain Professor of Surgery

Washington University School of Medicine

St. Louis, Missouri

Stéphane Collaud, MD, MSc

Department of Thoracic and Vascular Surgery and Heart-Lung Transplantation

Paris-Sud University

Marie Lannelongue Hospital

Le Plessis-Robinson, France

Willy Coosemans, MD, PhD

Clinic Head

Department of Thoracic Surgery

University Hospitals Leuven

Leuven, Belgium

Traves D. Crabtree, MD

Professor of Surgery

Southern Illinois University School of Medicine

Springfield, Illinois

Gerard J. Criner, MD

Professor and Chair

Department of Thoracic Medicine and Surgery

Lewis Katz School of Medicine at Temple University

Philadelphia, Pennsylvania

Richard S. D'Agostino, MD

Assistant Clinical Professor of Cardiothoracic Surgery

Tufts University School of Medicine

Boston Massachusetts

Chair

Division of Thoracic and Cardiovascular Surgery

Lahey Hospital and Medical Center

Burlington, Massachusetts

Walid Leonardo Dajer-Fadel, MD

Associate Professor

Department of Cardiothoracic Surgery

General Hospital of Mexico

Mexico City, Mexico

Thomas D'Amico, MD

Gary Hock Endowed Professor of Surgery

Chief, Section of General Thoracic Surgery

Program Director, Thoracic Surgery

Duke University Medical Center

Durham, North Carolina

Gail E. Darling, MD, FRCSC

Professor of Thoracic Surgery

University of Toronto

University Health Network, Toronto General Hospital

Toronto, Ontario, Canada

Philippe Dartevelle, MD

Professor of Thoracic and Cardiovascular Surgery

University Paris Sud

Marie Lannelongue Hospital

Le Plessis-Robinson, France

Hiroshi Date, MD

Professor and Chairman

Department of Thoracic Surgery

Kyoto University Graduate School of Medicine

Kyoto, Japan

Jonathan D'Cunha, MD, PhD

Associate Professor of Surgery

Vice Chairman
Research and Education
Chief
Division of Lung Transplantation/Lung Failure
Surgical Director, ECMO
Program Director
Thoracic Surgery Traditional Residency
Program Director
Advanced Lung/Heart Failure Fellowship
Department of Cardiothoracic Surgery
University of Pittsburgh Medical Center
Pittsburgh, Pennsylvania

Herbert Decaluwé, MD, PhD

Department of Thoracic Surgery
University Hospitals Leuven
Leuven, Belgium

Malcolm M. DeCamp, MD

Fowler McCormick Professor of Surgery
Northwestern University Feinberg School of Medicine
Chief, Division of Thoracic Surgery
Northwestern Memorial Hospital
Chicago, Illinois

Tracey Dechert, MD, FACS

Assistant Professor of Surgery
Boston University School of Medicine
Division of Trauma and Surgical Critical Care
Boston Medical Center
Boston, Massachusetts

Sebastián Defranchi, MD, MBA

Staff General Thoracic Surgeon
Chair, Patient Safety Department
Chair, Support Services Department
Hospital Universitario Fundación Favaloro
Ciudad de Buenos Aires, Argentina

Pierre Delaere, MD, PhD

Professor
Department of ENT, Head and Neck Surgery
University Hospitals Leuven
Leuven, Belgium

Paul De Leyn, MD, PhD

Professor
Chief, Department of Surgery

University Hospitals Leuven
Leuven, Belgium

Lorenzo Del Sorbo, MD

Assistant Professor
Interdepartmental Division of Critical Care Medicine
University of Toronto
University Health Network, Toronto General Hospital
Toronto, Ontario, Canada

Steven R. DeMeester, MD

Thoracic and Foregut Surgery
Division of General and Minimally Invasive Surgery
The Oregon Clinic
Portland, Oregon

Todd L. Demmy, MD

Professor of Oncology
Department of Thoracic Surgery
Roswell Park Cancer Institute
Professor
Department of Surgery
University of Buffalo, State University of New York
Buffalo, New York

Willem Adriaan den Hengst, MD, PhD

Resident
Department of Thoracic and Vascular Surgery
Antwerp University Hospital
Antwerp, Belgium

Chadrick E. Denlinger, MD

Associate Professor
Department of Surgery
Medical University of South Carolina
Charleston, South Carolina

Marc de Perrot, MD, MSc, FRCSC

Associate Professor of Surgery
Division of Thoracic Surgery
University of Toronto
University Health Network, Toronto General Hospital
Toronto, Ontario, Canada

Lieven P. Depypere, MD, FEBTS

Associate Clinical Head
Department of Thoracic Surgery
University Hospitals Leuven
Leuven, Belgium

Mathieu Derouet, PhD

Scientific Associate

Department of Thoracic Surgery

University Health Network

Toronto, Ontario, Canada

Daniele Diso, MD, PhD

Associate Professor

Department of Thoracic Surgery,

Sapienza University of Rome

Rome, Italy

Laura Donahoe, MD

Thoracic Surgeon

University of Toronto

University Health Network

Toronto General Hospital

Toronto, Ontario, Canada

Dean M. Donahue, MD

Assistant Professor

Department of Thoracic Surgery

Massachusetts General Hospital

Harvard Medical School

Boston, Massachusetts

Jessica S. Donington, MD, MSCR

Associate Professor

Department of Cardiothoracic Surgery

NYU School of Medicine

New York, New York

Frank D'Ovidio, MD, PhD

Associate Professor

Section General Thoracic Surgery

Department of Surgery

Columbia University

Attending Surgeon

New York-Presbyterian Hospital

New York, New York

Nigel E. Drury, PhD, FRCS(CTh)

Clinician Scientist & Consultant in Cardiothoracic Surgery

Birmingham Children's Hospital

Birmingham, United Kingdom

Lingling Du, MD

Department of Hematology and Medical Oncology

Ochsner Clinic Foundation

New Orleans, Louisiana

Mark R. Dylewski, MD

Chief of Thoracic Surgery

Miami Cancer Institute

Baptist Health of South Florida

Miami, Florida

Janet Edwards, MD, MPH

Assistant Professor

Division of Thoracic Surgery

Cumming School of Medicine at University of Calgary

Calgary, Alberta

Melanie A. Edwards, MD

Assistant Professor

Division of Cardiothoracic Surgery

Saint Louis University School of Medicine

Saint Louis, Missouri

Dominic Emerson, MD

Fellow

Cardiac Surgery

Cedars-Sinai Medical Center

Los Angeles, California

Elie Fadel, MD, PhD

Chief

Department of Thoracic and Vascular Surgery and Heart-Lung Transplantation

Hopital Marie Lannelongue and Université Paris Sud

Le Plessis-Robinson, France

Pierre-Emmanuel Falcoz, MD, PhD, FECTS

Department of Thoracic Surgery

Strasbourg University Hospital

Strasbourg, France

Farhood Farjah, MD, MPH

Associate Professor

Division of Cardiothoracic Surgery

University of Washington

Seattle, Washington

Richard H. Feins, MD

Professor of Surgery

Division of Cardiothoracic Surgery

University of North Carolina at Chapel Hill

Chapel Hill, North Carolina

Stanley C. Fell†

Professor of Cardiothoracic Surgery
Albert Einstein College of Medicine
Bronx, New York

Mark K. Ferguson, MD

Professor
Department of Surgery
University of Chicago Pritzker School of Medicine
Chicago, Illinois

Felix G. Fernandez, MD, MSc

Associate Professor of Surgery
General Thoracic Surgery
Emory University School of Medicine
Atlanta, Georgia

Hiran C. Fernando, MBBS, FRCS

Professor of Surgery
Virginia Commonwealth University
Richmond, Virginia
Inova Fairfax Medical Campus
Falls Church, Virginia

Pasquale Ferraro, MD

Professor
Department of Surgery
Chief
Division of Thoracic Surgery
Alfonso Minicozzi and Family Chair in Thoracic Surgery and Lung Transplantation
Centre Hospitalier de l'Université de Montréal
Montreal, Quebec

Raja M. Flores, MD

Chairman and Professor
Department of Thoracic Surgery
Icahn School of Medicine at Mount Sinai
New York, New York

Seth Force, MD

Professor
Department of Surgery
Emory University School of Medicine
Atlanta, Georgia

Richard K. Freeman, MD, MBA

System Chief Medical Officer
St Vincent Health
Indianapolis, Indiana

Joseph S. Friedberg, MD, FACS

Professor
University of Maryland School of Medicine
Thoracic Surgeon-in-Chief
Department of Surgery
Division of Thoracic Surgery
University of Maryland Medical System
Baltimore, Maryland

Henning A. Gaissert, MD

Associate Professor of Surgery
Harvard Medical School
Visiting Surgeon
Massachusetts General Hospital
Boston, Massachusetts

Sidhu P. Gangadharan, MD

Chief
Division of Thoracic Surgery and Interventional Pulmonology
Beth Israel Deaconess Medical Center
Associate Professor of Surgery
Harvard Medical School
Boston, Massachusetts

Perry Gerard, MD, FACP

Professor of Radiology and Medicine
Vice Chairman of Radiology
Director of Radiology IT
New York Medical College
Director of Nuclear Medicine and PET-CT
Westchester Medical Center
Valhalla, New York

Rafael Garza-Castillon, MD

Thoracic Surgery Fellow
Department of Thoracic Surgery
Brigham and Women's Hospital
Boston, Massachusetts

Ritu R. Gill, MD, MPH

Assistant Professor
Department of Radiology
Beth Israel Deaconess Medical Center
Harvard Medical School
Boston, Massachusetts

Erin A. Gillaspie, MD

Assistant Professor
Department of Thoracic Surgery

Vanderbilt University Medical Center
Nashville, Tennessee

Jason P. Glotzbach, MD

Assistant Professor
Division of Cardiothoracic Surgery
University of Utah
Salt Lake City, Utah

Diego Gonzalez-Rivas, MD, FECTS

Director Uniportal VATS Training Program
Department of Thoracic Surgery
Shanghai Pulmonary Hospital
Shanghai, China

Andrei-Bogdan Gorgos, MD

Associate Professor
Department of Radiology
University of Montreal
Montreal, Quebec

Dominique Gossot, MD

Head of Thoracic Department—IMM
Curie-Montsouris Thorax Institute
Paris, France

Ramaswamy Govindan, MD

Professor of Medicine
Anheuser-Busch Endowed Chair in Medical Oncology
Director, Section of Oncology
Division of Oncology
Washington University School of Medicine
St. Louis, Missouri

Gabriele Simone Grasso, MD

Department of Medicine and Surgery
University of Milano-Bicocca
Milan, Italy

Christina L. Greene, MD

Integrated Cardiac Resident
Department of Cardiothoracic Surgery
Stanford University School of Medicine
Stanford, California

Yosef Jose Greenspon, MD, FACS, FAAP

Assistant Professor
Department of Pediatrics
Division of Surgery
Cardinal Glennon Children's Hospital

St. Louis University School of Medicine

St. Louis, Missouri

Sean C. Grondin, MD, MPH, FRCSC, FACS

Professor and Head

Department of Surgery

Cumming School of Medicine at University of Calgary

Calgary Zone Clinical Department Head

Alberta Health Services

Foothills Medical Centre

Calgary, Alberta

Federica Grosso, MD

Department of Oncology

SS Antonio e Biagio General Hospital

Alessandria, Italy

Shawn S. Groth, MD, MS

Assistant Professor

Department of Surgery

Baylor College of Medicine

Houston, Texas

Dominique Grunenwald, MD, PhD

Professor Emeritus

Department of Thoracic and Cardiovascular Surgery

Pierre and Marie Curie University

Paris, France

Claude Guinet, MD

Radiologist

Department of Radiology

Paris Center University Hospital

Paris, France

Julian Guitron, MD

Associate Professor

Department of Surgery

Division of Thoracic Surgery

University of Cincinnati

Cincinnati, Ohio

Jinny S. Ha, MD

Cardiothoracic Surgery Fellow

Division of Thoracic Surgery

Johns Hopkins Hospital

Baltimore, Maryland

Hironori Haga, MD

Department of Pathology

Kyoto University Hospital

Kyoto, Japan

Semih Halezeroğlu, MD, FETCS

Professor and Chief

Department of Thoracic Surgery

Acibadem University School of Medicine

Istanbul, Turkey

Matthew G. Hartwig, MD, MHS

Associate Professor of Surgery

Division of Thoracic Surgery

Duke University Health System

Durham, North Carolina

Dominik Harzheim, MD

Department of Pneumology and Critical Care

Thoraxklinik, University of Heidelberg

Heidelberg, Germany

Stephen Hazelrigg, MD

Professor and Chairman

Department of Cardiothoracic Surgery

Southern Illinois University School of Medicine

Springfield, Illinois

Mark W. Hennon, MD

Assistant Professor

Department of Surgery

University at Buffalo, State University of New York

Assistant Professor of Oncology

Department of Thoracic Surgery

Roswell Park Cancer Institute

Buffalo, New York

Claudia I. Henschke, PhD, MD

Department of Radiology

Icahn School of Medicine at Mount Sinai

New York, New York

Felix J. F. Herth, MD, PhD, FCCP, FERS

CMO

Department of Pneumology and Critical Care Medicine

Thoraxklinik, University of Heidelberg

Heidelberg, Germany

Nicholas R. Hess, MD

Resident

Department of Cardiothoracic Surgery

University of Pittsburgh Medical Center

Pittsburgh, Pennsylvania

Maxime Heyndrickx, MD

Department of Thoracic Surgery
University Hospital of Caen
Caen, France

Wayne Hofstetter, MD

Professor of Surgery and Deputy Chair
Department of Thoracic and Cardiovascular Surgery
University of Texas MD Anderson Cancer Center
Houston, Texas

Young K. Hong, MD

Surgical Oncology and Hepatopancreatobiliary Fellow
Department of Surgery
Louisville, Kentucky

Yinin Hu, MD

Resident
Department of Surgery
University of Virginia
Charlottesville, Virginia

James Huang, MD

Associate Attending Surgeon
Thoracic Service, Department of Surgery
Memorial Sloan Kettering Cancer Center
New York, New York

Miriam Huang, MD

Clinical Assistant Professor
Department of Surgery
Jacobs School of Medicine & Biomedical Sciences
University of Buffalo
Buffalo, New York

Charles B. Huddleston, MD

Professor
Department of Surgery
St. Louis University School of Medicine
St. Louis, Missouri

Jessica L. Hudson, MD, MPHS

Surgical Resident
Department of Surgery
Washington University
St. Louis, Missouri

Mark D. Iannettoni, MD, MBA

W. Randolph Chitwood, Jr., MD, Distinguished Chair in Cardiovascular Sciences
Professor and Chief
Division of Thoracic and Foregut Surgery
Program Director
Thoracic Surgery Residency
Chief
Cardiovascular Service Line
East Carolina Heart Institute at Vidant Medical Center
Greenville, North Carolina

Carlos Ibarra-Pérez, MD

Master and Doctor in Medical Sciences
University of México
Honorary Consultant in Thoracic Surgery
Instituto Nacional de Cardiología Ignacio Chavez
México City, Mexico

Kendra Iskander, MD, MPH

General Surgeon
St. Joseph Hospital
Eureka, California

Dawn E. Jaroszewski, MD, MBA, FACS

Professor of Surgery
Department of Cardiothoracic Surgery
Mayo Clinic
Phoenix, Arizona

Leila Jazayeri, MD

Plastic and Reconstructive Surgeon
Kaiser Permanente San Leandro Medical Center
San Leandro, California

Scott B. Johnson, MD

Division Chief, General Thoracic Surgery
Department of Cardiothoracic Surgery
UT Health San Antonio
San Antonio, Texas

David W. Johnstone, MD

Division of Cardiothoracic Surgery
Medical College of Wisconsin
Milwaukee, Wisconsin

David R. Jones, MD

Professor and Chief
Thoracic Surgery Service
Fiona and Stanly Druckenmiller Chair for Lung Cancer Research
Memorial Sloan Kettering Cancer Center

New York, New York

Erkan Kaba, MD

Assistant Professor

Department of Thoracic Surgery

Istanbul Bilim University

Istanbul, Turkey

Mohamed K. Kamel, MD

Clinical Fellow

Department of Cardiothoracic Surgery

Weill Cornell Medical College

New York Presbyterian Hospital

New York, New York

Neil Kapadia, MD

Assistant Professor

Department of Radiology

Temple University

Philadelphia, Pennsylvania

Brian J. Karlovits, DO

Director of Clinical Operations

Assistant Professor

Department of Radiation Oncology

UPMC Hillman Cancer Center—Shadyside

Pittsburgh, Pennsylvania

Shaf Keshavjee, MD, FRCSC, FACS

Professor, Division of Thoracic Surgery

University of Toronto

James Wallace McCutcheon Chair in Surgery

Surgeon in Chief

University Health Network

Toronto, Ontario, Canada

Onkar V. Khullar, MD

Assistant Professor

Division of Cardiothoracic Surgery

Emory University School of Medicine

Atlanta, Georgia

Biniam Kidane, MD, MSc, FRCSC

Assistant Professor

Section of Thoracic Surgery

Department of Surgery

University of Manitoba

Winnipeg, Manitoba

Min P. Kim, MD

Associate Professor
Chief, Division of Thoracic Surgery
Department of Surgery
Houston Methodist Hospital
Houston, Texas

Jacob A. Klapper, MD

Assistant Professor of Surgery
Duke University Hospital
Durham, North Carolina

Patrick Kohtz, MD

Resident
Department of Surgery
University of Colorado Anschutz Medical Campus
Aurora, Colorado

Rupesh Kotecha, MD

Department of Radiation Oncology
Cleveland Clinic, Taussig Cancer Institute
Cleveland, Ohio
Department of Radiation Oncology
Miami Cancer Institute
Baptist Health South Florida
Miami, Florida

Vasileios Kouritas, MD, PhD, CTh

Cardiothoracic Surgeon
Department of Thoracic Surgery
St. James's University Hospital
Leeds, United Kingdom

Benjamin D. Kozower, MD, MPH

Professor
Department of Surgery
Washington University School of Medicine
St. Louis, Missouri

Seth B. Krantz, MD

Division of Thoracic Surgery
NorthShore University HealthSystem
Evanston, Illinois
Clinical Assistant Professor
Department of Surgery
University of Chicago Pritzker School of Medicine
Chicago, Illinois

Mark J. Krasna, MD

Clinical Professor of Surgery

Rutgers New Jersey Medical School
Newark, New Jersey
Hackensack Meridian School of Medicine at Seton Hall University
South Orange, New Jersey

Daniel Kreisel, MD, PhD

Professor of Surgery, Pathology and Immunology
Surgical Director, Lung Transplant Program
Washington University School of Medicine
St. Louis, Missouri

Alexander Krupnick, MD

Department of Surgery
Division of CT Surgery
University of Virginia
Charlottesville, Virginia

Kiran Lagisetty, MD

Assistant Professor
Section of Thoracic Surgery
Department of Surgery
University of Michigan
Ann Arbor, Michigan

Francesca Lanfranconi, MD, PhD

Research Officer
Institute of Sport, Exercise and Active Living (ISEAL)
Victoria University
Melbourne, Australia

Jacob C. Langer, MD

Professor of Surgery
University of Toronto
Pediatric Surgeon
The Hospital for Sick Children
Toronto, Ontario, Canada

Nathaniel B. Langer, MD, MSc

Department of Thoracic and Vascular Surgery and Heart-Lung Transplantation
Marie Lannelongue Hospital
Le Plessis-Robinson, France

Michael Lanuti, MD

Associate Professor of Surgery
Harvard Medical School
Director of Thoracic Oncology
Division of Thoracic Surgery
Massachusetts General Hospital
Boston, Massachusetts

Rossano Lattanzio, MD, PhD, Dr.

Researcher

Department of Medical, Oral and Biotechnological Sciences

University "G. d'Annunzio"

Chieti, Italy

Christine Lau, MD, MBA

Professor of Surgery

Chief, Division of Thoracic Surgery

University of Virginia

Charlottesville, Virginia

Kelvin Lau, MA(Oxon), DPhil(Oxon), FRCS(CTh)

Chief of Thoracic Surgery

St. Bartholomew's Hospital

London, United Kingdom

Richard S. Lazzaro, MD, FACS

Associate Professor of Cardiothoracic Surgery

Department of Cardiothoracic Surgery

Donald and Barbara Zucker School of Medicine at Hofstra/Northwell

Chief

Division of Thoracic Surgery

Lenox Hill Hospital

Director, Robotic Thoracic Surgery

Northwell Health

New York, New York

Dong-Seok Daniel Lee, MD

Assistant Professor

Department of Thoracic Surgery

Mount Sinai Health System

New York, New York

Toni Lerut, MD, PhD

Emeritus Professor of Surgery

Emeritus Chairman, Department of Thoracic Surgery

University Hospitals Leuven, Gasthuisberg Campus

Leuven, Belgium

Gunda Leschber, MD

Head of Department of Thoracic Surgery

ELK Berlin Chest Hospital

Berlin, Germany

Kunwei Li, MD

Department of Radiology

Icahn School of Medicine at Mount Sinai

New York, New York

Moishe Liberman, MD, PhD

Director, CETOC

Associate Professor of Surgery

Division of Thoracic Surgery

University of Montreal

Montreal, Quebec

Michael J. Liptay, MD

Professor and Chairman

Department of Cardiovascular and Thoracic Surgery

Rush University Medical Center

Chicago, Illinois

Virginia R. Litle, MD

Professor of Surgery

Chief of Thoracic Surgery

Boston University

Boston, Massachusetts

Joseph LoCicero III, MD

Professor Emeritus of Surgery

SUNY Downstate Medical Center

Brooklyn, New York

Consultant

Mobile County Health Department

Mobile, Alabama

Jason Michael Long, MD, MPH

Assistant Professor

Department of Surgery

UNC Medical Center

Chapel Hill, North Carolina

Christine Lorut, MD

Unit of Pneumology

Hôpital Cochin, APHP

Paris, France

Donald E. Low, MD, FACS, FRCS(C)

Head of Thoracic Surgery and Thoracic Oncology

Department of General, Thoracic and Vascular Surgery

Virginia Mason Medical Center

Seattle, Washington

James D. Luketich, MD, FACS

Henry T. Bahnson Professor and Chairman

Department of Cardiothoracic Surgery

Chief, Division of Thoracic and Foregut Surgery

University of Pittsburgh School of Medicine

Pittsburgh, Pennsylvania

Audrey Lupo, MD, PhD

Department of Pathology

Hôpitaux Universitaires Paris Centre

Paris, France

Ronson J. Madathil, MD

Acting Assistant Professor

Division of Cardiothoracic Surgery

University of Washington

Seattle, Washington

Mitchell J. Magee, MD, MS

Chief

Division of Thoracic Surgery

Medical City Dallas Hospital

Dallas, Texas

Raja Mahidhara, MD

Thoracic Surgery

St Vincent Health

Indianapolis, Indiana

J. Shawn Mallery, MD

Associate Professor of Medicine

Department of Medicine

Division of Gastroenterology, Hepatology and Nutrition

University of Minnesota

Minneapolis, Minnesota

Mirella Marino, MD

Department of Pathology

Regina Elena National Cancer Institute

Rome, Italy

M. Blair Marshall, MD, FACS

Professor of Surgery

Chief, Division of Thoracic Surgery

Department of Surgery

MedStar Georgetown University Hospital

Washington, District of Columbia

Gilbert Massard, MD

Professor

Department of Thoracic Surgery and Lung Transplantation

Strasbourg University Hospital

Strasbourg, France

Douglas J. Mathisen, MD

Hermes C. Grillo Professor of Surgery
Harvard Medical School
Chief
General Thoracic Surgery
Massachusetts General Hospital
Boston, Massachusetts

Giulio Maurizi, MD

Division of Thoracic Surgery
Sapienza University of Rome
Sant' Andrea Hospital
Rome, Italy

Donna E. Maziak, MDCM, MSc, FRCSC, FACS

Professor
University of Ottawa
Surgical Oncology Division of Thoracic Surgery
Ottawa Hospital—General Campus
Ottawa, Ontario

Daniel P. McCarthy, MD, MBA

Assistant Professor
Department of Surgery
University of Wisconsin
Madison, Wisconsin

Paul Michael McFadden, MD

Professor of Clinical Cardiothoracic Surgery
Surgical Co-Director of Lung Transplantation
Division of Cardiothoracic Surgery
Department of Surgery
University of Southern California
Los Angeles, California

Rachel L. Medbery, MD

Thoracic Surgery Fellow
Department of Surgery
Division of Cardiothoracic Surgery
Emory University School of Medicine
Atlanta, Georgia

Robert A. Meguid, MD, MPH, FACS

Associate Professor
Section of General Thoracic Surgery
Division of Cardiothoracic Surgery
Department of Surgery
University of Colorado Anschutz Medical Campus
Aurora, Colorado

Babak J. Mehrara, MD

Professor and Chief, Plastic and Reconstructive Surgery Service
William G. Cahon Chair in Surgery
Memorial Sloan Kettering Cancer Center
New York, New York

Steven J. Mentzer, MD

Professor of Surgery
Brigham and Women's Hospital
Harvard Medical School
Boston, Massachusetts

Robert E. Merritt, MD

Associate Professor of Surgery
Director
The Division of Thoracic Surgery
The Ohio State University Wexner Medical Center
Columbus, Ohio

Giuseppe Miserocchi, MD

Professor of Physiology and Biophysics
Department of Medicine and Surgery
University Milano-Bicocca
Milan, Italy

John D. Mitchell, MD

Courtenay C. and Lucy Patten Davis Endowed Chair in Thoracic Surgery
Professor and Chief, Section of General Thoracic Surgery
Division of Cardiothoracic Surgery
University of Colorado Anschutz Medical Campus
Aurora, Colorado

Kamran Mohiuddin, MD

Director Clinical Research
Einstein Medical Center
Philadelphia, Pennsylvania

Elie Mouhayar, MD

Associate Professor of Medicine
Department of Cardiology
University of Texas MD Anderson Cancer Center
Houston, Texas

Michael S. Mulligan, MD

Professor of Surgery
Chief
Division of Cardiothoracic Surgery
University of Washington
Seattle, Washington

Michael S. Mulvihill, MD

Resident in Surgery
Department of Surgery
Duke University Medical Center
Durham, North Carolina

Sudish C. Murthy, MD, PhD, FACS, FCCP

Department of Thoracic and Cardiovascular Surgery
Cleveland Clinic
Cleveland, Ohio

Philippe Nafteux, MD, PhD

Clinical Head
Department of Thoracic Surgery
University Hospitals Leuven
Leuven, Belgium

Chaitan K. Narsule, MD

Assistant Professor
Department of Surgery
Boston University School of Medicine
Boston, Massachusetts

Basil Nasir, MBBCh

Division of Thoracic Surgery
Centre Hospitalier de l'Université de Montréal
Montreal, Quebec

Keith S. Naunheim, MD

The Vallee and Melba Willman Chair of Surgery
Chief of Thoracic Surgery
Department of Surgery
Saint Louis University School of Medicine
St. Louis, Missouri

Calvin S. H. Ng, BSc, MD, FRCSEd(CTh), FCCP

Associate Professor
Department of Surgery
The Chinese University of Hong Kong
Hong Kong, SAR, China

Daniel G. Nicastrì, MD

Assistant Professor
Department of Thoracic Surgery
Icahn School of Medicine at Mount Sinai
New York, New York

Francis C. Nichols, MD

Professor of Surgery
Consultant General Thoracic Surgery

Mayo Clinic
Rochester, Minnesota

David M. Notrica, MD, FACS, FAAP

Associate Professor
University of Arizona College of Medicine
Tuscan, Arizona
Associate Professor of Surgery
Mayo Clinic School of Medicine
Division of Pediatric Surgery
Phoenix Children's Hospital
Phoenix, Arizona

Daniel Ocazonez, MD

Assistant Professor
Department of Diagnostic and Interventional Imaging
University of Texas HSC at Houston
Houston, Texas

Matthias Ochs, MD

Professor and Chair
Institute of Functional and Applied Anatomy
Hannover Medical School
Hannover, Germany

John A. Odell, MBChB, FRCS(Ed), FACS

Emeritus Professor of Surgery
Mayo Clinic
Jacksonville, Florida

Amaia Ojanguren, MD, PhD

Associate Professor of Surgery
University of Lleida
Division of Thoracic Surgery
Arnau de Vilanova University Hospital
Lleida, Spain
Institut Catala de la Salut
Barcelona, Spain

Anne Olland, MD, PhD

Associate Professor
Department of Thoracic Surgery
Strasbourg University Hospital
Strasbourg, France

Mark Onaitis, MD

Associate Professor of Surgery
University of California San Diego
La Jolla, California

Raymond P. Onders, MD

Professor and Chief of General Surgery
Case Western Reserve University School of Medicine
University Hospitals Cleveland Medical Center
Cleveland, Ohio

Isabelle Opitz, MD

Associate Professor
Department of Thoracic Surgery
University Hospital Zurich
Zurich, Switzerland

Asishana Osho, MD, MPH

Clinical Fellow
Department of Surgery
Massachusetts General Hospital
Harvard Medical School
Boston, Massachusetts

Berker Özkan, MD

Associate Professor
Department of Thoracic Surgery
Istanbul Medical School
Istanbul University
Istanbul, Turkey

Siddharth Padmanabhan, MBBS, LLB, BCom

Resident
Latrobe Regional Hospital
Victoria, Australia

Hao Pan, MD

Chief Resident
Department of Cardiothoracic Surgery
UT Health San Antonio
San Antonio, Texas

Kostas Papagiannopoulos, MD, MMED THORAX (CTH)

Honorary Senior Lecturer
Leeds University
Department of Thoracic Surgery
St. James's University Hospital
Leeds, United Kingdom

Nadeem Parkar, MD

Chief
Section of Thoracic and Cardiac Imaging
Assistant Professor of Radiology
Assistant Professor of Internal Medicine

Saint Louis University School of Medicine
Saint Louis, Missouri

G. Alexander Patterson, MD

Joseph C. Bancroft Professor of Surgery
Division of Cardiothoracic Surgery
Washington University
St. Louis, Missouri

Edoardo Pescarmona, MD

Department of Pathology
Regina Elena National Cancer Institute
Rome, Italy

Adrienne A. Phillips, MD, MPH

Assistant Professor of Medicine
Department of Medicine
Division of Hematology and Medical Oncology
Weill Cornell Medical College
New York, New York

Joseph D. Phillips, MD

Assistant Professor
Department of Surgery
Dartmouth-Hitchcock Medical Center
Lebanon, New Hampshire

Anthony L. Picone, MD, PhD, MBA

Professor of Oncology
Department of Thoracic Surgery
Roswell Park Cancer Institute
Buffalo, New York

Eitan Podgaetz, MD, MPH, FACS

Associate Professor
Texas A&M University
Director of Minimally Invasive Thoracic Surgery
Center for Thoracic Surgery
Baylor University Medical Center
Dallas, Texas

Cecilia Pompili, MD

Thoracic Surgeon
Leeds Institute of Cancer and Pathology
University of Leeds
St James's University Hospital
Leeds, United Kingdom

Jeffrey L. Port, MD

Professor of Clinical Cardiothoracic Surgery

Weill Cornell Medical College
Associate Attending
New York Presbyterian Hospital
New York, New York

Ciprian Pricopi, MD

Department of Thoracic Surgery
Georges Pompidou European Hospital
Paris, France

Varun Puri, MD, MSCI

Associate Professor
Department of Surgery
Washington University
St. Louis, Missouri

Joe B. Putnam, Jr., MD, FACS

Medical Director
Baptist MD Anderson Cancer Center
Jacksonville, Florida

Siva Raja, MD, PhD, FACS

Professional Staff, Thoracic Surgery
Surgical Director, Center for Esophageal Diseases
Heart and Vascular Institute
Cleveland Clinic Foundation
Cleveland, Ohio

Arvind Rajagopal, MBBS

Assistant Professor
Department of Anesthesiology
Rush University Medical Center
Chicago, Illinois

Ravi Rajaram, MD, MSc

General Surgery Resident
Department of Surgery
Northwestern University Feinberg School of Medicine
Chicago, Illinois

Pala Babu Rajesh, FRCS Ed, FRCS CTh, FRCS Eng

Consultant Thoracic Surgeon
Regional Department of Thoracic Surgery
Birmingham Heartlands Hospital
Birmingham, United Kingdom

Prabhakar Rajiah, MBBS, MD, FRCR

Associate Professor of Radiology
Associate Director of Cardiac CT and MRI
Department of Radiology, Cardiothoracic Radiology

UT Southwestern Medical Center
Dallas, Texas

Karthik Ravi, MD

Assistant Professor of Medicine
Department of Gastroenterology and Hepatology
Mayo Clinic
Rochester, Minnesota

Rishindra M. Reddy, MD

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

James Regan, MD

Department of Surgery
Southern Illinois University School of Medicine
Springfield, Illinois

Jean-François Regnard

Professor of Thoracic Surgery
Head
Department of Thoracic Surgery
Paris Descartes University
Hôpital Cochin, APHP
Paris, France

Janani S. Reisenauer, MD

Department of Pulmonary Medicine
Division of Thoracic Surgery
Mayo Clinic
Rochester, Minnesota

Erino A. Rendina, MD

Chief, Division of Thoracic Surgery
Sapienza University of Rome
Rome, Italy

Carlos S. Restrepo

Professor of Radiology
Director of Cardiothoracic Radiology
UT Health San Antonio
San Antonio, Texas

David Rice, MB, BCh, BAO, FRCSI

Department of Thoracic and Cardiovascular Surgery
University of Texas MD Anderson Cancer Center
Houston, Texas

Thomas W. Rice, MD

Professor
Department of Surgery
Cleveland Clinic Lerner College of Medicine
Section Head, Department of Thoracic Surgery
Cleveland Clinic
Cleveland, Ohio

Marc Riquet, MD, PhD

Professor
Department of Thoracic Surgery
Georges Pompidou European Hospital
Paris, France

Valerie W. Rusch, MD

Professor
Department of Surgery
Weill Cornell Medical College
Chief, Thoracic Service
William G. Cahan Chair
Department of Surgery
Memorial Sloan-Kettering Cancer Center
New York, New York

Michele Salati, MD, PhD

Unit of Thoracic Surgery
University Hospital Ancona United Hospitals
Ancona, Italy

Mary Salvatore, MD

Associate Professor
Department of Radiology
Mount Sinai Health System
New York, New York

Pamela Samson, MD

Resident Physician
Department of Surgery
Washington University in St. Louis
St. Louis, Missouri

Nicola Santelmo, MD

Hôpital Civil de Strasbourg
Strasbourg, France

Inderpal (Netu) S. Sarkaria, MD

Vice Chairman, Clinical Affairs
Department of Cardiothoracic Surgery
University of Pittsburgh School of Medicine

University of Pittsburgh Medical Center
Pittsburgh, Pennsylvania

Giorgio V. Scagliotti

Professor of Medical Oncology
Department of Oncology
University of Turin
Torino, Italy

Eric Sceusi, MD

Thoracic Surgeon
Piedmont Heart Institute
Atlanta, Georgia

Lara Schaheen, MD

Chief Resident
Department of Cardiothoracic Surgery
University of Pittsburgh Medical Center
Pittsburgh, Pennsylvania

Philip Maximilian Scherer, MD

Assistant Professor of Radiology
University of Central Florida College of Medicine
Florida Hospital
Orlando, Florida
Radiology Specialists of Florida
Maitland, Florida

Colin Schieman, MD, FRCSC

Clinical Associate Professor
Residency Program Director
Section of Thoracic Surgery
Cumming School of Medicine at University of Calgary
Calgary, Alberta

David S. Schrupp, MD, MBA, FACS

Senior Investigator and Chief
Thoracic and General Surgical Oncology Branch
Center for Cancer Research
National Cancer Institute
Bethesda, Maryland

Matthew J. Schuchert, MD

Associate Professor
Department of Cardiothoracic Surgery
University of Pittsburgh Medical Center
Pittsburgh, Pennsylvania

Christopher W. Seder, MD

Assistant Professor

Department of Cardiovascular and Thoracic Surgery
Rush University Medical School
Chicago, Illinois

Agathe Seguin-Givelet, MD, PhD

Department of Thoracic
Curie-Montsouris Thorax Institute
Paris, France

Joanna Sesti, MD

Department of Cardiothoracic Surgery
Robert Wood Johnson Barnabas Health System
Livingston, New Jersey

Farid M. Shamji, MBBS, FRCSC, FACS

Professor of Surgery
Division of Thoracic Surgery
University of Ottawa
Ottawa Hospital—General Campus
Ottawa, Ontario, Canada

Jason P. Shaw, MD

Chief
Department of General Thoracic Surgery
Maimonides Medical Center
Brooklyn, New York

David D. Shersher, MD

Assistant Professor
Department of Surgery
Cooper Medical School of Rowan University
MD Anderson Cancer Center
Camden, New Jersey

Thomas W. Shields, MD, DSc (Hon.)†

Professor Emeritus of Surgery
Northwestern University Feinberg School of Medicine
Chicago, Illinois

Joseph B. Shrager, MD

Professor of Cardiothoracic Surgery
Stanford University School of Medicine
Chief, Division of Thoracic Surgery
Stanford Cancer Institute
Stanford, California

Antonios C. Sideris

Research Fellow
Division of Thoracic Surgery
Brigham and Women's Hospital

Harvard Medical School
Boston, Massachusetts
Resident
Department of General Surgery
Cleveland Clinic Foundation
Cleveland, Ohio

Alan D. L. Sihoe, MA(Cantab), FRCSEd(CTh), FCSHK, FHKAM, FCCP

Clinical Associate Professor
Department of Surgery
Chief of Thoracic Surgery
The University of Hong Kong
HKU Shenzhen Hospital
Hong Kong, China

Mark A. Socinski, MD

Executive Medical Director
Member, Thoracic Oncology Program
Florida Hospital Cancer Institute
Orlando, Florida

Joshua R. Sonett, MD

Professor and Chief
Thoracic Surgery
Columbia University
New York Presbyterian Hospital
New York, New York

Nathaniel J. Soper, MD, FACS

Loyal and Edith Davis Professor and Chair
Department of Surgery
Northwestern University Feinberg School of Medicine
Chief of Surgery
Northwestern Medicine
Chicago, Illinois

James E. Speicher, MD

Assistant Professor
Department of Cardiovascular Sciences
Division of Thoracic and Foregut Surgery
East Carolina University
Greenville, North Carolina

Jonathan D. Spicer, MD, PhD, FRCS

Assistant Professor
Division of Thoracic Surgery
Dr. Ray Chiu Distinguished Scientist in Surgical Research
McGill University

Montreal, Canada

Laurence N. Spier

Chief

Division of Thoracic Surgery

NYU-Winthrop University Hospital

Mineola, New York

Sandra Starnes, MD

Professor of Surgery

John B. Flege Chair in Cardiothoracic Surgery

University of Cincinnati College of Medicine

Cincinnati, Ohio

Kevin L. Stephans, MD

Associate Professor

Department of Radiation Oncology

Cleveland Clinic, Taussig Cancer Center

Cleveland, Ohio

Joel Miller Sternbach, MD, MBA

Bechily-Hodes Fellow in Esophagology

Department of Surgery

Northwestern University, Feinberg School of Medicine

Chicago, Illinois

Hon Chi Suen, MBBS, FRCSEd, FRCS, RCPS(Glasg), FCSHK, FACS, DABThS, DABS

President

Center for Cardiothoracic Surgery, Inc.

St. Louis, Missouri

David J. Sugarbaker, MD

Professor and Chief

Division of Thoracic Surgery

Baylor College of Medicine

Houston, Texas

Kei Suzuki, MD

Assistant Professor

Department of Surgery

Boston Medical Center

Boston, Massachusetts

Scott J. Swanson, MD

Director

Minimally Invasive Thoracic Surgery

Vice Chair

Cancer Affairs

Brigham and Women's Hospital

Chief Surgical Office

Dana Farber Cancer Institute
Professor of Surgery
Harvard Medical School
Boston, Massachusetts

Gunturu N. Swati, MD

Government Medical College Akola
Visiting student
Icahn School of Medicine at Mount Sinai Hospital
New York, New York

Ezra N. Teitelbaum, MD, MEd

Assistant Professor of Surgery and Medical Education
Department of Surgery
Northwestern University, Feinberg School of Medicine
Chicago, Illinois

Sara Tenconi, MD

Consultant Thoracic Surgeon
Sheffield Teaching Hospitals
United Kingdom

Michael Thomas, MD

Assistant Professor
Department of Surgery
Southern Illinois University School of Medicine
Springfield, Illinois

Pascal A. Thomas, MD

Professor and Chief
Department of Thoracic Surgery
North University Hospital–Aix-Marseille University
Marseille, France

Prashanthi N. Thota, MD, FACP

Medical Director
Esophageal Center
Director
Center for Swallowing and Motility Disorders
Digestive Disease & Surgery Institute
Cleveland Clinic
Cleveland, Ohio

Alper Toker, MD

Head
Department of Thoracic Surgery
Istanbul University, Istanbul Faculty of Medicine
Istanbul, Turkey

Victor F. Trastek, MD

Director of Science of Healthcare Delivery
College of Healthcare Solutions
Arizona State University
Phoenix, Arizona
Consultant in Leadership and Professionalism
Mayo Clinic
Scottsdale, Arizona

H. Adam Ubert, MD

Attending Cardiothoracic Surgeon
Department of Cardiovascular Medicine
Charleston Area Medical Center
Charleston, West Virginia

Eric Vallières, MR, FRCSC

Surgical Director of the Lung Cancer Program
Medical Director
Division of Thoracic Surgery
Swedish Cancer Institute
Seattle, Washington

Victor van Berkel, MD, PhD

Associate Professor
Department of Cardiovascular and Thoracic Surgery
University of Louisville School of Medicine
Louisville, Kentucky

Koen van Besien, MD, PhD

Director, Stem Cell Transplant Program
Division of Hematology/Oncology
Weill Cornell Medical College
New York, New York

Dirk Van Raemdonck, MD, PhD

Professor of Surgery
KU Leuven University
Head of Transplant Center
University Hospitals Leuven
Leuven, Belgium

Paul E. Y. Van Schil, MD, PhD

Chair
Department of Thoracic and Vascular Surgery
Antwerp University Hospital and Antwerp University
Antwerp, Belgium

Hans Van Veer, MD

Assistant Clinic Head
Department of Thoracic Surgery

University Hospitals Leuven
Leuven, Belgium

Ara A. Vaporciyan, MD, FACS

Professor and Chairman
Department of Thoracic and Cardiovascular Surgery
University of Texas MD Anderson Cancer Center
Houston, Texas

Nirmal K. Veeramachaneni, MD

Department of Thoracic Surgery
University of Kansas Medical Center
Kansas City, Kansas

Federico Venuta, MD

Professor of Thoracic Surgery and Chief
Sapienza University of Rome
Policlinico Umberto I
Rome, Italy

Gregory Videtic, MD, CM, FRCPC, FACR

Professor of Medicine
Cleveland Clinic Lerner College of Medicine
Staff Physician
Department of Radiation Oncology
Cleveland Clinic
Cleveland, Ohio

Carlos Vigliano, MD

Associate Professor
Instituto de Medicina Traslacional, Trasplante y Bioingeniería (IMeTTyB)
Favaloro University–CONICET
Chief
Department of Pathology
University Hospital Favaloro Foundation
Buenos Aires, Argentina

Liza Villaruz, MD

Assistant Professor of Medicine
Department of Medicine
University of Pittsburgh School of Medicine
Pittsburgh, Pennsylvania

Robin Vos, MD, PhD

Department of Respiratory Medicine, Lung Transplant and Respiratory Intermediate Care Unit University
Hospitals Leuven, Gasthuisberg Campus
Assistant Professor of Medicine
Department of Chronic Diseases, Metabolism and Ageing (CHROMETA)
Lab of Respiratory Diseases, KU

Leuven, Belgium

David Waller, FRCS(CTh)

Consultant Thoracic Surgeon
St. Bartholomew's Hospital
London, United Kingdom

Garrett L. Walsh, MD

Professor of Surgery
Department of Thoracic and Cardiovascular Surgery
University of Texas MD Anderson Cancer Center
Houston, Texas

Saiama N. Waqar, MBBS, MSCI

Assistant Professor of Medicine
Division of Oncology
Washington University School of Medicine
St. Louis, Missouri

William H. Warren, MD†

Professor
Department of Cardiovascular Surgery
Rush University Medical Center
Chicago, Illinois

Thomas J. Watson, MD, FACS

Professor of Surgery
Georgetown University School of Medicine
Regional Chief of Surgery
MedStar Washington
Washington, District of Columbia

Jon O. Wee, MD

Section Chief, Esophageal Surgery
Co-Director of Minimally Invasive Thoracic Surgery
Director of Robotics in Thoracic Surgery
Division of Thoracic Surgery
Brigham and Women's Hospital
Boston, Massachusetts

Ewald R. Weibel, MD, DSc(hon)

Professor Emeritus
Institute of Anatomy
University of Bern
Bern, Switzerland

Mark Weir, MBChB

Assistant Professor
Department of Thoracic Medicine and Surgery
Lewis Katz School of Medicine at Temple University

Philadelphia, Pennsylvania

Michael J. Weyant, MD

Professor of Surgery

Department of Surgery

Division of Cardiothoracic Surgery

University of Colorado

Aurora, Colorado

Abby White, DO

Division of Thoracic Surgery

Brigham and Women's Hospital

Boston, Massachusetts

Ory Wiesel, MD

Clinical Fellow

Division of Thoracic Surgery

Brigham and Women's Hospital

Harvard Medical School

Boston, Massachusetts

Dennis A. Wigle, MD, PhD

Associate Professor

Division of General Thoracic Surgery

Mayo Clinic

Rochester, Minnesota

Elbert E. Williams, MD

Department of Cardiothoracic Surgery

Mount Sinai Health System

New York, New York

Jennifer L. Wilson, MD

Department of Thoracic Surgery

Beth Israel Deaconess Medical Center

Instructor of Surgery

Harvard Medical School

Boston, Massachusetts

Douglas E. Wood, MD, FACS, FRCSEd

The Henry N. Harkins Professor and Chair

Department of Surgery

University of Washington

Seattle, Washington

Neil McIver Woody, MD, MS

Associate Staff

Department of Radiation Oncology

Cleveland Clinic, Taussig Cancer Institute

Cleveland, Ohio

Cameron Wright, MD

Douglas Mathisen Professor of Surgery
Division of Thoracic Surgery
Massachusetts General Hospital
Harvard Medical School
Boston, Massachusetts

Moritz C. Wyler von Ballmoos, MD, PhD, MPH, FACC

Clinical Associate in Surgery
Division of Cardiothoracic Surgery
Duke University Medical Center
Durham, North Carolina

Alexander Yang, MS

MD Candidate, Class of 2020
GW School of Medicine and Health Sciences
Washington, District of Columbia

Chi-Fu Jeffrey Yang, MD

Resident
Department of Surgery
Duke University
Durham, North Carolina

Stephen C. Yang, MD

The Arthur B. and Patricia B. Modell Endowed Chair in Thoracic Surgery
Professor of Surgery and Oncology
The Johns Hopkins Medical Institutions
Baltimore, Maryland

David Yankelevitz, MD

Professor
Department of Radiology
Icahn School of Medicine
New York, New York

Anjana Yeldandi, MD

Associate Professor of Pathology
Northwestern Memorial Hospital
Feinberg Pavilion
Chicago, Illinois

Sai Yendamuri, MD, FACS

Professor and Chair
Department of Thoracic Surgery
Roswell Park Cancer Institute
Buffalo, New York

Jonathan C. Yeung, MD, PhD, FRCSC

Assistant Professor
Division of Thoracic Surgery
University of Toronto
Toronto, Ontario

Akihiko Yoshizawa, MD, PhD

Associate Professor
Department of Diagnostic Pathology
Kyoto University Hospital
Kyoto, Japan

Masaya Yotsukura, MD

Assistant
Division of Thoracic Surgery
Keio University School of Medicine
Tokyo, Japan

David S. Younger, MD, MPH, MS

Clinical Associate Professor
Department of Neurology
School of Medicine and College of Global Public Health
New York University
New York City, New York

Yachao Zhang, MD

Department of Radiology
Westchester Medical Center
Valhalla, New York

Ze-Rui Zhao, MD

Department of Surgery
Prince of Wales Hospital
Hong Kong, China

Yifan A. Zheng, MD

Resident
Department of Surgery
Division of Thoracic Surgery
Brigham and Women's Hospital
Harvard Medical School
Boston, Massachusetts

Brittany A. Zwischenberger, MD

Cardiothoracic Surgery Fellow
Division of Cardiovascular and Thoracic Surgery
Duke University
Durham, North Carolina

Joseph "Jay" B. Zwischenberger, MD

Johnston-Wright Professor and Chairman

Department of Surgery
University of Kentucky
Lexington, Kentucky

†Deceased

Preface to the Eighth Edition

In the foreword to the first edition of *General Thoracic Surgery* published in 1972, Paul Samson noted that Shields published a text dedicated to the General Thoracic Surgeon to the exclusion of the heart. That occurred at a time when the “romance and appeal which have attended the astounding developments in the surgical treatment of cardiac disease” was skyrocketing.

During the next 40 years of cardiac surgical dominance on the international stage, Shields’ book remained focused on the diseases of the lungs, esophagus, chest wall, diaphragm, and mediastinum. The first text, penned by 58 specialists, was encyclopedic in scope and depth. Students and practitioners of this specialty needed no other book. Through its many editions, it carried the same thorough approach and served as the *de facto* bible of the specialty.

Over the decades, other books, atlases and manuals on General Thoracic Surgery have come and gone, but this book has remained the only comprehensive text in continuous publication for the practitioner of thoracic diseases, excluding the heart and great arteries.

In the current digital age, seekers of knowledge no longer rely solely on the static text. They often begin their search for information by scouring the Internet for a variety of media for articles, videos, meeting reports, videos and other tidbits to understand the nuances of a particular disease or procedure. While more dynamic than searching the texts of old, these searches often are hampered by search terms, are disorganized, narrow in scope, and evanescent.

Now, 45 years after the first publication, this edition of *Shields’ General Thoracic Surgery* is written by over 150 specialists. It has shed its encyclopedic tradition while maintaining its completeness. It includes dynamic audio and visual content, color coordinated graphics, and analyses of the world’s literature and electronic data for the most extensive and concise collection of information for the busy clinician.

For the first time, the edition includes a retrospective into the past with particular attention to the milestones of artificial ventilation and the era of minimal invasion, both of which revolutionized the century-old specialty. It also addresses new topics such as deciphering complex statistical analyses, using efficiently the new World Health Organization’s International Classification of Diseases (ICD-10), mining big data sets for specific decision making, and developing and performing effective quality improvement projects for the surgeon’s practice and hospital setting.

Long-time users of *Shields* will enjoy the continued comprehensiveness of the chapters. Millennial practitioners will find this transformed edition less ponderous and intimidating than the tomes of the past, yet more thorough and meaningful than imprecise, often fragmented individual electronic searches.

Preface to the First Edition

This volume was prepared to present a comprehensive text on the surgical diseases of the chest wall, pleura, diaphragm, trachea, lung, and mediastinal structures. Initially, an overview of the anatomy and of the physiology of these structures is given. The investigation of the patient's disease and the management of the patient in the perioperative period are considered next. The various operative approaches and the standard surgical procedures are discussed and these are followed by chapters concerned with the disease entities of the aforementioned structures. The major objectives are to present a summation of the current knowledge and the clinical concepts of the surgical management of trauma and diseases of the thorax. The pathophysiologic alterations produced and the corrections of these by appropriate intervention are emphasized throughout. Presentations of the clinical features, pathologic changes, surgical management, operative results, and prognosis of the various disease states are included as an integral part of the whole.

Outstanding surgeons, physicians, and scientists have cooperated in the preparation of the text. As with most multi-authored books, repetition could not be completely eliminated; however, I have tried to keep it at a minimum. In most instances, the repetition serves to emphasize important information relative to the entire subject. Interestingly, conflicting statements are few, and only an occasional footnote has been appended to point out such differences in opinion. This book hopefully will serve as a source of information for the young thoracic surgeon and the person in surgical training. It also should serve as a reference for surgeons, as well as physicians, outside the field of general thoracic surgery who wish to ascertain the current views held by the specialty.

TWS

Acknowledgments

Any large textbook such as this one, an army of individuals is required to produce a quality work. The editors appreciate the efforts of the publishers, the artists, and the printers assigned to this project.

Most of all, it is the volunteers who really make the text worthwhile. We thank the authors and co-authors who composed the original content and those who updated the old content. In addition, we thank their administrative assistants who participated in the production of the content.

In particular, the editors wish to acknowledge two volunteers who sacrificed a great deal of personal time and expended their intellectual energy to improve the quality of the book.

From the inception of this edition, Bryan F. Meyers, MD has been a strong advocate and a driving force. He participated in the development of the revised table of contents and in the editor discussions of the revised chapter format. Most importantly, he helped recruit a number of national and international authors.

Special thanks goes to Martha S. LoCicero, MD, who performed substantial copyediting duties in an effort to make the text readable and relevant. She also provided the much needed advice and encouragement over the long development phase of this project.

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†Deceased

Part
A

**EVOLUTION OF GENERAL THORACIC
SURGERY**

Section

I

HISTORY AND PIONEERS IN THORACIC SURGERY

The History of Thoracic Surgery

John A. Odell

“Let me repeat what history teaches, history teaches.”

—Gertrude Stein

In this chapter important issues of how a correct diagnosis was achieved, how the pleural space needed to be controlled, and how an ability to control major blood vessels and to close a bronchial stump arose. For the older surgeons, the story is reasonably well known but for those entering the specialty it needs retelling. For the sake of brevity and continuity, I have concentrated on the challenges that needed to be overcome and included within these sections the pioneers who popularized a surgical approach. Inevitably, there will be some who were involved with more than one approach, and some who will be left out of the record. I have not attempted to include every pioneer, nor every surgical variation, nor every surgical first. Many of the early procedures were done in the belief that radical surgery was necessary to deal with the underlying disease process and many were simply published to show that a procedure was possible, but with no evidence that the procedure prolonged or improved the quality of life. It is also difficult to describe the small progressive steps that inevitably take place over a continuum of time. The first faltering steps are obviously described but the reader will need to imagine the further progress to the present.

The subject of our surgical history actually deserves space for a book. For those wishing a more comprehensive tome there are two excellent reviews. Mead’s book¹ is almost too comprehensive, and many will find the description of virtually every operation until the time of publication irksome, yet gems of information can be found within. Alternatively, the chapter by Molnar² is excellent and gives a more inclusive European perspective than other historical chapters, but is limited, as this chapter will be, by editorial restrictions imposed in a reference book chapter. Nevertheless, both this chapter and Molnar’s provide references for those wishing to further explore the subject.

Most of the developments that affected thoracic surgery occurred between the World Wars. My description will stop in approximately 1950, when advances in anesthesia (paralytic agents, halothane, and pentobarbital [pentothal] all introduced in that decade) enabled routine intratracheal ventilation and thoracic surgery safer. There will be some overlap with the subsequent chapter. Also, at that time, antituberculous drugs became widely available and changed the nature of thoracic surgery in a very dramatic fashion.³ Within a decade and a half of the discovery of antituberculous drugs, specialties of cardiac surgery and pulmonology, started to form.

INTRODUCTION

It is not known exactly when the first thoracic surgical procedure was performed, but we can readily

understand the chest pathology the early physician had to deal with: traumatic wounds and the consequences of infection. Two early classic descriptions to set the stage for management of these pathologic processes are provided.

The first description is that of Hippocrates translated from Fuchs' edition.⁴

If as a result of the treatments the pus does not break through, one should not be surprised, for often it breaks into the body, and the patient seems to be better, because the pus has passed from a narrow space to a larger one. As time goes on, the fever becomes more severe, coughing begins, the side begins to pain, the patient cannot lie any more on the healthy side but on the diseased side, the feet and eyes swell.

When the fifteenth day after the rupture has appeared, prepare a warm bath, set him upon a stool, which is not wobbly, someone should hold his hands, then shake him by his shoulders and listen to see on which side a noise is heard. And right at this place—preferably on the left—make an incision, then it produces death more rarely.

Those cases of empyema or dropsy which are treated by incision or the cautery, if the water or pus flows rapidly all at once, certainly prove fatal. When empyema is treated either by the cautery or incision, if pure and white pus flow from the wound, the patients recover, but if mixed with blood, slimy and fetid, they die.

The second is by Barron Larrey,⁵ Napoleon's surgeon, describing a soldier injured during the Egypt campaign of 1798.

A soldier was brought to the hospital of the Fortress of Ibrahym Bey, immediately after a wound penetrated the thorax, between the fifth and sixth true ribs. It was about 8 cm in extent. A large quantity of frothy and vermilion blood escaped from it with a hissing noise at each inspiration. His extremities were cold, pulse scarcely perceptible, countenance discolored, and respiration short and laborious; in short, he was every moment threatened with a fatal suffocation.

After having examined the wound, the divided edges of the part, I immediately approximated the two lips of the wound, and retained them by means of adhesive plaster and a suitable bandage around the body. In adopting this plan, I intended only to hide from the sight of the patient and his comrades, the distressing spectacle of a hemorrhage, which would soon prove fatal; and I therefore thought that the effusion of blood into the cavity could not increase the danger. But the wound was scarcely closed, when he breathed more freely and felt easier. The heat of the body soon returned, and the pulse rose. In a few hours he became quite calm, and to my great surprise, grew better. He was cured in a very few days and without difficulty.

Hippocrates, described a possible lung abscess with rupture either into the bronchus or pleural space; his description of the symptoms and signs of a bronchopleural fistula was excellent. He knew that early intervention in the disease process was dangerous and never did drainage until 15 days had passed. In this setting, Hippocrates was able to differentiate pus of a parapneumonic effusion (commonly *Streptococcus pneumoniae*), which tends to be watery and thin (enzymes streptokinase and streptodornase) from that of a likely staphylococcal empyema (enzyme coagulase results in the formation of a rapid cortex on the surface of the lung) and to recognize, either an anaerobic or amebic empyema.

What both these famous clinicians described was an open pneumothorax and its consequences. Hippocrates' patient with thick white pus has a better prognosis than that with thin watery pus because a cortex has developed on the pleural surface of the lung, preventing collapse when the sub atmospheric pleural space was opened and exposed to higher atmospheric pressure.

The lesson was not lost. One of the orders issued in the First World from an Allied Commander about open chest wounds was one issued by WG MacPherson⁶ for the Director Medical Service, British Armies in France.

"An open pneumothorax should be temporarily closed by suture at the earliest opportunity, either in the field ambulance, or at the Casualty Clearing Station. If for any reason suturing is impossible, the wound should be strapped, so as to render it air tight."

This issue, collapse of the lung and its consequences when the pleural space is entered, was an enormous barrier to early surgery within the chest and hindered surgical development, shape, and type until the first quarter of the 20th century. The history of thoracic surgery has at its core the management of

the pleural space and this problem will rear its head repeatedly in the descriptions that follow. It should be remembered that this was an era without oximeters, EKG monitors, blood banks, endotracheal tubes, and antibiotics. Many of the early procedures pursued were designed simply to avoid entering the pleural space, because it was safer for the patient.

AN ACCURATE DIAGNOSIS

One of the tenets of any planned surgical procedure is an accurate diagnosis. In the 19th century, the ability to make a diagnosis was limited. A symptomatic empyema necessitans or a traumatic chest wound was an obvious reason for surgical intervention, but it was difficult to determine if intrathoracic pathology required intervention. Skoda⁷ had popularized percussion and Laennec⁸ auscultation, but the ability to use these aids were limited by clinical ability. Nevertheless, some clinicians had confidence in their ability. One such surgeon was Block⁹ of Danzig, who had performed successful pulmonary resections in rabbits. Convinced he could do it safely in humans he operated on his cousin in 1883 with the presumption that she had bilateral apical tuberculosis. She unfortunately died and at postmortem no evidence of tuberculosis was found. The distraught Block committed suicide. (Authors note: This description of Block operating on his cousin can be found in numerous textbooks dealing with the history of thoracic surgery, but none have been referenced [not too surprising as the protagonist had killed himself].)

In the late 1800s and early 1900s, the most common cause of death was tuberculosis. It was apparent to many that tuberculosis was a communicable disease. In fact, Villemin,¹⁰ a French army surgeon, had proven so by reproducing the pathologic features of the disease by injecting caseous material from a deceased patient with tuberculosis into the trachea of rabbits, but his research was largely ignored. Medical proof had to await Koch's presentation, entitled "Die Tuberculose" (On Tuberculosis), to the Berlin Physiologic Society on March 24, 1882. The electrifying atmosphere that developed at the presentation is vividly described in the book "The Forgotten Plague" by Frank Ryan.¹¹ Present in the crowded room were Virchow, Loeffler, and Ehrlich, who described "*that evening to be the most important experience of my scientific life.*" Three weeks after the presentation, the lecture was published.¹² Twelve days later an English summary was published in the *London Times*, and a few weeks later, on May 3, it was published in *The New York Times*. The rapidity of the spread of the news and its publication in the lay press testify to how common and threatening tuberculosis was at the time. Naturally it was thought that surgical resection may have a role in management of such a life-threatening disease. This was how planned thoracic surgery started. If we study the history of thoracic surgery we study surgical attempts to control tuberculosis.¹³

RADIOLOGY

Tuberculosis could now be suspected and proven by examining sputa, but the extent of disease had to wait until 1895 when Roentgen discovered x-rays.¹⁴ The ability to visualize shadows within the chest and correlate radiographic findings with pathology at autopsy was now at hand.

ESOPHAGOSCOPY

The bronchoscope and esophagoscope were developments that followed laryngoscopy and cystoscopy.