

Contents

VOLUME 1

PART 1 SCIENTIFIC PRINCIPLES OF RESPIRATORY MEDICINE

SECTION A

Anatomy and Development of the Respiratory Tract, 3

- 1 Anatomy, 3**
KURT H. ALBERTINE, MARIA I. RAMIREZ, RORY E. MORTY
- 2 Lung Growth and Development, 24**
XIN SUN, DAVID MCCULLEY
- 3 Alveolar Compartment, 33**
WILLIAM J. ZACHARIAS, MICHAEL F. BEERS, ZEA BOROK
- 4 Airway Biology, 49**
STEVEN L. BRODY, CHRISTOPHER M. EVANS
- 5 Lung Mesenchyme, 66**
GAUTAM GEORGE, MARIA I. RAMIREZ, JESSE ROMAN
- 6 Vascular Biology, 76**
YUANSHENG GAO, WOLFGANG M. KUEBLER, J. USHA RAJ
- 7 Lymphatic Biology, 88**
SOUHEIL EL-CHEMALY, HASINA OUTTZ REED
- 8 Regeneration and Repair, 96**
SUSANNE HEROLD, GREGORY P. DOWNEY
- 9 Genetics of Lung Disease, 106**
MICHAEL H. CHO, DAVID A. SCHWARTZ

SECTION B

Respiratory Physiology, 116

- 10 Ventilation, Blood Flow, and Gas Exchange, 116**
MEREDITH C. MCCORMACK, JOHN B. WEST
- 11 Respiratory System Mechanics and Energetics, 140**
KRISTEN M. KIDSON, NAJIB T. AYAS, WILLIAM R. HENDERSON
- 12 Acid-Base Balance, 154**
SARAH SANGHAVI, TYLER J. ALBERT, ERIK R. SWENSON
- 13 Aerosols and Drug Delivery, 168**
THOMAS G. O'RIORDAN, GERALD C. SMALDONE
- 14 Pleural Physiology and Pathophysiology, 180**
V. COURTNEY BROADDUS

SECTION C

Defense Mechanisms and Immunology, 191

- 15 Innate Immunity, 191**
CLAUDIA V. JAKUBZICK, ELIZABETH F. REDENTE, DAVID W.H. RICHES, THOMAS R. MARTIN
- 16 Adaptive Immunity, 208**
ANDREW P. FONTENOT, SHAIKH M. ATIF, R. LEE REINHARDT
- 17 Microbiome, 228**
GEORGIOS KITSIOS, BRYAN J. MCVERRY, ALISON MORRIS

PART 2 DIAGNOSIS AND EVALUATION OF RESPIRATORY DISEASE

SECTION D

Diagnosis, 241

- 18 History and Physical Examination, 241**
ELAINE FAJARDO, J. LUCIAN DAVIS
- 19 Microbiologic Diagnosis of Lung Infection, 254**
NIAZ BANAEI, STANLEY C. DERESINSKI, BENJAMIN A. PINSKY
- 20 Thoracic Radiology: Noninvasive Diagnostic Imaging, 272**
CLINTON E. JOKERST, MICHAEL B. GOTWAY
- 21 Thoracic Radiology: Invasive Diagnostic Imaging and Image-Guided Interventions, 300**
RYAN WALSH, JEFFREY S. KLEIN
- 22 Pathology: Neoplastic and Non-neoplastic Lung Disease, 312**
ANATOLY URISMAN, KIRK D. JONES, STEPHEN L. NISHIMURA
- 23 Ultrasonography: Principles and Basic Thoracic and Vascular Imaging, 330**
AMY E. MORRIS, ROSEMARY ADAMSON, JAMES FRANK
- 24 Ultrasonography: Advanced Applications and Procedures, 343**
CHRISTOPHER F. BARNETT, DANIEL A. SWEENEY, LINDSEY L. HUDDLESTON
- 25 Positron Emission Tomography, 355**
CHRISTOPHE M. DEROOSE, CHRISTOPHE DOOMS
- 26 Diagnostic Bronchoscopy: Basic Techniques, 368**
ELIF KÜPELI, ATUL C. MEHTA

27 Diagnostic Bronchoscopy: Advanced Techniques (EBUS and Navigational), 376

A. CHRISTINE ARGENTO, AJAY WAGH, DAVID FELLER-KOPMAN

28 Therapeutic Bronchoscopy: Interventional Techniques, 388

DAVID FELLER-KOPMAN, SAMIRA SHOJAEI

29 Thoracoscopy, 399

NAJIB M. RAHMAN, MOHAMMED MUNAWWAR

30 Thoracic Surgery, 412

SHAMUS R. CARR, JOSEPH FRIEDBERG

SECTION E

Evaluation, 424

31 Pulmonary Function Testing: Physiologic and Technical Principles, 424

NIRAV R. BHAKTA, DAVID A. KAMINSKY

32 Pulmonary Function Testing: Interpretation and Applications, 439

NIRAV R. BHAKTA, SURYA P. BHATT

33 Exercise Testing, 454

ANDREW M. LUKS, ROBB W. GLENNY

34 Preoperative Evaluation, 472

KURT PFEIFER, GERALD W. SMETANA

35 Evaluation of Respiratory Impairment and Disability, 480

ANNYCE S. MAYER, LISA A. MAIER

PART 3 CLINICAL RESPIRATORY MEDICINE

SECTION F

Evaluation of Common Presentations of Respiratory Disease, 497

36 Dyspnea, 497

RICHARD M. SCHWARTZSTEIN, LEWIS ADAMS

37 Cough, 508

KIAN FAN CHUNG, STUART B. MAZZONE

38 Chest Pain, 521

BRETT E. FENSTER, TEOFILO L. LEE-CHIONG JR, G.F. GEBHART, RICHARD A. MATTHAY

39 Wheezing And Stridor, 532

JESSICA B. BADLAM, DAVID A. KAMINSKY

40 Hemoptysis, 539

YARON B. GESTHALTER, FAYEZ KHEIR

41 Pulmonary Nodule, 548

NICHOLE T. TANNER, MICHAEL GOULD, CHRISTOPHER G. SLATORE

42 Positive Screening Test for Tuberculosis, 559

CHRISTINA YOON

43 Aspiration, 569

RUPAL J. SHAH, VYVY N. YOUNG

44 Hypoxemia, 578

V. COURTNEY BROADDUS, ANTONIO GOMEZ

45 Hypercapnia, 590

BERNIE Y. SUNWOO, BABAK MOKHLESI

SECTION G

Infectious Diseases of the Lungs, 600

46 Community-Acquired Pneumonia, 600

DAVID H. DOCKRELL, ANTONIA HO, STEPHEN B. GORDON

46a COVID-19, 620

MONICA FUNG, JENNIFER M. BABIK, JOHN S. MUNGER, DAVID A. KAUFMAN

47 Influenza, 634

JUSTIN R. ORTIZ, T. EOIN WEST

48 Hospital-Acquired Pneumonia, 646

MARK L. METERSKY, ANDRE C. KALIL

49 Ventilator-Associated Pneumonia, 657

JEAN CHASTRE, CHARLES-EDOUARD LUYT

50 Lung Abscess, 668

NISHA H. GIDWANI

51 Tuberculosis: Epidemiology and Prevention, 674

PHILIP C. HOPEWELL, MIDORI KATO-MAEDA

52 Tuberculosis: Pathogenesis and Immunity, 684

JENNIFER A. PHILLIPS, JOEL D. ERNST

53 Tuberculosis: Clinical Manifestations and Diagnosis, 692

PRIYA B. SHETE, ADITHYA CATTAMANCHI, CHRISTINA YOON

54 Tuberculosis: Treatment of Drug-Susceptible and Drug-Resistant, 708

DAVID J. HORNE, PAYAM NAHID

55 Nontuberculous Mycobacterial Infections, 725

CHARLES L. DALEY, KEVIN L. WINTHROP, DAVID E. GRIFFITH

56 Fungal Infections: Endemic, 748

JOSHUA D. NOSANCHUK, GEORGE R. THOMPSON III

57 Fungal Infections: Opportunistic, 763

JENNIFER L. SAULLO, BARBARA D. ALEXANDER

58 Parasitic Infections, 781

KAMI KIM, LOUIS M. WEISS

59 Outbreaks, Pandemics, and Bioterrorism, 797

WILLIAM A. FISCHER II, DAVID A. WOHL, DAVID J. WEBER, NICOLE LURIE

SECTION H**Obstructive Diseases, 807**

- 60** *Asthma: Pathogenesis and Phenotypes*, 807
PRESCOTT G. WOODRUFF, NIRAV R. BHAKTA, VICTOR ENRIQUE ORTEGA, BART N. LAMBRECHT, JOHN V. FAHY
- 61** *Asthma and Obesity*, 825
ANNE E. DIXON, MICHAEL C. PETERS
- 62** *Asthma: Diagnosis and Management*, 831
NJIRA LUGOGO, LORETTA G. QUE, TARA F. CARR, MONICA KRAFT
- 63** *COPD: Pathogenesis and Natural History*, 850
JEFFREY L. CURTIS, MICHAEL H. CHO, NADIA N. HANSEL
- 64** *COPD: Diagnosis and Management*, 870
MEILAN K. HAN, STEPHEN C. LAZARUS
- 65** *Smoking Hazards: Cigarettes, Vaping, Marijuana*, 890
JEFFREY E. GOTTS, NEAL L. BENOWITZ
- 66** *Smoking Cessation*, 900
PAUL G. BRUNETTA, LISA KROON
- 67** *Cystic Fibrosis: Pathogenesis And Epidemiology*, 910
STEVEN M. ROWE, GEORGE M. SOLOMON, ERIC J. SORSCHER
- 68** *Cystic Fibrosis: Diagnosis and Management*, 919
GEORGE M. SOLOMON, WYNTON HOOVER, ERIC J. SORSCHER, STEVEN M. ROWE
- 69** *Bronchiectasis*, 941
GEORGE M. SOLOMON, EDWARD D. CHAN
- 70** *Upper Airway Disorders*, 961
CLARK A. ROSEN, STEVEN D. PLETCHER
- 71** *Large Airway Disorders*, 982
LAKSHMI MUDAMBI, MESHHELL JOHNSON, SUIL KIM
- 72** *Bronchiolitis*, 994
JOHN R. GREENLAND, KIRK D. JONES, JONATHAN P. SINGER

VOLUME 2**SECTION I****Neoplasms of the Lung, 1005**

- 73** *Lung Cancer: Molecular Biology and Targets*, 1005
PIERRE P. MASSION, JONATHAN M. LEHMAN
- 74** *Lung Cancer: Epidemiology*, 1018
DAVID C. CHRISTIANI, CHRISTOPHER I. AMOS
- 75** *Lung Cancer: Screening*, 1029
LYNN TANOUE, PETER J. MAZZONE, NICHOLE T. TANNER
- 76** *Lung Cancer: Diagnosis and Staging*, 1039
NICHOLAS J. PASTIS, ANNE V. GONZALEZ, GERARD A. SILVESTRI

- 77** *Lung Cancer: Treatment*, 1052
M. PATRICIA RIVERA, GITA N. MODY, ASHLEY A. WEINER

- 78** *Rare Primary Lung Tumors*, 1066
NICOLAS GIRARD, DOMINIQUE GOSSOT, LARA CHALABREYSSE, JACQUES CADRANEL

- 79** *Metastatic Malignant Tumors*, 1080
DOUGLAS A. ARENBERG, RISHINDRA M. REDDY

- 80** *Benign Lung Tumors*, 1091
KRISTINE KONOPKA, DOUGLAS A. ARENBERG

SECTION J**Disorders of the Pulmonary Circulation, 1101**

- 81** *Pulmonary Thromboembolism: Presentation and Diagnosis*, 1101
TIMOTHY A. MORRIS, ALEXANDRA ROSE
- 82** *Pulmonary Thromboembolism: Prophylaxis and Treatment*, 1123
BRUCE L. DAVIDSON, C. GREGORY ELLIOTT
- 83** *Pulmonary Hypertension: General Approach*, 1141
MATTHEW R. LAMMI, STEPHEN C. MATHAI
- 84** *Pulmonary Arterial Hypertension: Group 1*, 1159
SONJA D. BARTOLOME, KELLY M. CHIN
- 85** *Pulmonary Hypertension Due to Lung Disease: Group 3*, 1171
CHRISTOPHER F. BARNETT, TERESA DE MARCO
- 86** *Pulmonary Hypertension Due to Chronic Thromboembolic Disease: Group 4*, 1185
TIMOTHY M. FERNANDES, KIM M. KERR
- 87** *Pulmonary Vasculitis*, 1194
KEVIN K. BROWN, STEPHEN K. FRANKEL, CARLYNE D. COOL
- 88** *Pulmonary Vascular Anomalies*, 1212
VIKRAMADITYA PRABHUDESAI, MARIE E. FAUGHNAN

SECTION K**Infiltrative and Interstitial Lung Diseases, 1221**

- 89** *Idiopathic Pulmonary Fibrosis*, 1221
JAY H. RYU, MOISÉS SELMAN, JOYCE S. LEE, THOMAS V. COLBY, TALMADGE E. KING JR
- 90** *Nonspecific Interstitial Pneumonitis and Other Idiopathic Interstitial Pneumonias*, 1235
BRIDGET A. GRANEY, JOYCE S. LEE, TALMADGE E. KING JR
- 91** *Hypersensitivity Pneumonitis*, 1248
KERRI A. JOHANNSON, EVANS R. FERNÁNDEZ PÉREZ
- 92** *Connective Tissue Diseases*, 1262
TAMERA J. CORTE, ATHOL U. WELLS

- 93 Sarcoidosis, 1284**
MARC A. JUDSON, LAURA L. KOTH, ROBERT P. BAUGHMAN
- 94 Diffuse Alveolar Hemorrhage, 1301**
MARVIN I. SCHWARZ, SCOTT MATSON
- 95 Pulmonary Langerhans Cell Histiocytosis and Other Rare Diffuse Infiltrative Lung Diseases, 1314**
ISABEL C. MIRA-AVENDANO, ROBERT VASSALLO
- 96 Eosinophilic Lung Diseases, 1322**
VINCENT COTTIN
- 97 Lymphangiomyomatosis, 1343**
FRANCIS X. MCCORMACK, NISHANT GUPTA, YOSHIKAZU INOUE
- 98 Pulmonary Alveolar Proteinosis Syndrome, 1363**
BRUCE C. TRAPNELL, CORMAC MCCARTHY
- 99 Drug-Induced Pulmonary Disease, 1378**
ANDREW H. LIMPER

SECTION L

Environmental and Occupational Hazards, 1395

- 100 Asthma in the Workplace, 1395**
CATHERINE LEMIERÉ, OLIVIER VANDENPLAS
- 101 Pneumoconioses, 1409**
LEONARD H.T. GO, ROBERT A. COHEN
- 102 Indoor and Outdoor Air Pollution, 1423**
JOHN RANDOLPH BALMES, STEPHANIE M. HOLM
- 103 Acute Responses to Toxic Exposures, 1435**
WARE G. KUSCHNER, PAUL D. BLANC
- 104 Trauma and Blast Injuries, 1447**
D. DANTE YEH, JARONE LEE
- 105 High Altitude, 1460**
ANDREW M. LUKS, ROBERT B. SCHOENE, ERIK R. SWENSON
- 106 Air Travel, 1475**
UMUR HATIPOĞLU, JAMES K. STOLLER
- 107 Diving Medicine, 1486**
MICHAEL S. LIPNICK, KAREN B. VAN HOESEN

SECTION M

Disorders of the Pleura, 1498

- 108 Pleural Effusion, 1498**
V. COURTNEY BROADDUS, RICHARD W. LIGHT
- 109 Pleural Infections, 1524**
ANNA C. BIBBY, NICK A. MASKELL
- 110 Pneumothorax, 1539**
ROB HALLIFAX, NAJIB RAHMAN

- 111 Chylothorax, 1551**
KEN K.P. CHAN, STUART M. LYON, Y.C. GARY LEE
- 112 Pleural Fibrosis and Unexpandable Lung, 1560**
AMELIA O. CLIVE, RAHUL BHATNAGAR

- 113 Hemothorax, 1570**
JOSEPH FRIEDBERG, SHELBY J. STEWART

- 114 Pleural Malignancy, 1575**
HELEN E. DAVIES, DANIEL STERMAN, Y.C. GARY LEE

SECTION N

Disorders of the Mediastinum, 1590

- 115 Mediastinal Tumors and Cysts, 1590**
MATTHEW TRIPLETTE, THOMAS K. VARGHESE JR., GUANG-SHING CHENG
- 116 Mediastinitis and Fibrosing Mediastinitis, 1605**
ROBERT J. LENTZ, JAMES E. LOYD

SECTION O

Disorders of Sleep and Control of Breathing, 1618

- 117 Control of Breathing and Upper Airways During Sleep, 1618**
RICHARD L. HORNER, ATUL MALHOTRA
- 118 Consequences of Sleep Disruption, 1633**
VIDYA KRISHNAN, SANJAY R. PATEL
- 119 Sleep-Disordered Breathing: A General Approach, 1643**
ROBERT HIENSCH, NEOMI SHAH, KATHLEEN F. SARMIENTO
- 120 Obstructive Sleep Apnea, 1654**
R. JOHN KIMOFF, MARTA KAMINSKA, SUSHMITA PAMIDI
- 121 Central Sleep Apnea, 1670**
CLODAGH M. RYAN, T. DOUGLAS BRADLEY
- 122 Sleep-Disordered Breathing: Treatment, 1687**
STANLEY YUNG-CHUAN LIU, ANNA M. MAY, REENA MEHRA

SECTION P

Respiratory Manifestations of Extrapulmonary Disorders, 1703

- 123 Pulmonary Complications of HIV Infection, 1703**
KRISTINA CROTHERS, WILLIAM WORODRIA, LAURENCE HUANG
- 124 Pulmonary Complications of Primary Immunodeficiencies, 1728**
JAMES W. VERBSKY, JOHN M. ROUTES
- 125 Pulmonary Complications of Stem Cell and Solid Organ Transplantation, 1745**
GUANG-SHING CHENG, STEVEN A. PERGAM

126 *Pulmonary Complications of Abdominal Diseases, 1758*

MELISSA H. TUKEY, BRYON D. QUICK, HILARY DUBROCK

127 *Pulmonary Complications of Hematologic Diseases, 1773*

ROBERTO F. MACHADO, MARK T. GLADWIN

128 *Pulmonary Complications of Endocrine Diseases, 1788*

WON Y. LEE, CONNIE C.W. HSIA

129 *The Lungs in Obstetric and Gynecologic Diseases, 1799*

STEPHEN E. LAPINSKY, CATHERINE NELSON-PIERCY

130 *The Respiratory System and Neuromuscular Diseases, 1812*

F. DENNIS MCCOOL, JANET HILBERT, LISA F. WOLFE, JOSHUA O. BENDITT

131 *The Respiratory System and Chest Wall Diseases, 1829*

GEORGE E. TZELEPIS, ERIC J. GARTMAN, F. DENNIS MCCOOL

SECTION Q

Management of Respiratory Failure, 1843

132 *Acute Ventilatory Failure, 1843*

NICHOLAS S. HILL, ERIK GARPESTAD, GREGORY L. SCHUMAKER

133 *Pulmonary Edema, 1860*

NUALA J. MEYER, MICHAEL A. MATTHAY

134 *Acute Respiratory Distress Syndrome, 1880*

ALEXANDRA BINNIE, MARGARET S. HERRIDGE, WARREN L. LEE

135 *Mechanical Ventilation, 1903*

EWAN C. GOLIGHER, EDDY FAN

136 *Noninvasive Support of Ventilation, 1918*

LAURENT J. BROCHARD, DAN E. ADLER, RICARDO LUIZ CORDIOLI, EVANGELIA AKOUMIANAKI

137 *Noninvasive Support of Oxygenation, 1931*

SHIJING JIA, ROBERT C. HYZY

138 *Extracorporeal Support of Gas Exchange, 1939*

NICOLÒ PATRONITI, GIACOMO GRASSELLI, ALBERTO ZANELLA, ANTONIO PESENTI

139 *Pulmonary Rehabilitation, 1951*

CAROLYN L. ROCHESTER, LINDA NICI

140 *Lung Transplantation, 1964*

ROBERT M. KOTLOFF, SHAF KESHAVJEE

141 *End-of-Life Care in Respiratory Failure, 1980*

RENEE D. STAPLETON, DOUGLAS B. WHITE

Appendix, A-1