

# Contents

## VOLUME 1

### PART I

#### Introduction

##### Chapter 1

*Scope of Modern Anesthetic Practice* 2

LARS I. ERIKSSON • JEANINE P. WIENER-KRONISH • NEAL H. COHEN • LEE A. FLEISHER • RONALD D. MILLER

##### Chapter 2

*International Scope, Practice, and Legal Aspects of Anesthesia* 10

MARIA J.C. CARMONA • YUGUANG HUANG • LARS I. ERIKSSON • JANNICKE MELLIN-OLSEN • DEEPAK K. TEMPE • NAOYUKI HIRATA • MICHIAKI YAMAKAGE • ANIS BARAKA • FOUAD SALIM HADDAD • YURY S. POLUSHIN • OLGA N. AFONIN • FLORIAN R. NUEVO • GUILLERMO LEMA • D.G. BOGOD • RONALD D. MILLER

##### Chapter 3

*Perioperative Management* 48

NEAL H. COHEN

##### Chapter 4

*Operating Room Management* 56

JAMES D. KINDSCHER

##### Chapter 5

*Medical Informatics* 73

C. WILLIAM HANSON

##### Chapter 6

*Quality Improvement and Patient Safety* 87

ELIZABETH A. MARTINEZ • ANNA M. VARUGHESE • DAVID W. BUCK • EUGENIE S. HEITMILLER

##### Chapter 7

*Human Performance and Patient Safety* 106

MARCUS RALL • DAVID M. GABA • STEVEN K. HOWARD • PETER DIECKMANN

##### Chapter 8

*Patient Simulation* 167

MARCUS RALL • DAVID M. GABA • PETER DIECKMANN • CHRISTOPH BERNHARD EICH

##### Chapter 9

*Teaching Anesthesia* 210

MANUEL PARDO, JR. • RANDALL M. SCHELL

##### Chapter 10

*Ethical Aspects of Anesthesia Care* 232

GAIL A. VAN NORMAN • STANLEY H. ROSENBAUM

##### Chapter 11

*Legal Aspects of Anesthesia Care in America* 251

DAVID B. WAISEL

##### Chapter 12

*Anesthesia Business Models* 268

NEIL H. COHEN • LARS I. ERIKSSON

## PART II

### Anesthetic Physiology

##### Chapter 13

*Consciousness, Memory, and Anesthesia* 282

GEORGE A. MASHOUR • KANE O. PRYOR

##### Chapter 14

*Sleep Medicine* 303

SEBASTIAN ZAREMBA • NANCY L. CHAMBERLIN • MATTHIAS EIKERMANN

##### Chapter 15

*Perioperative and Anesthesia Neurotoxicity* 329

RODERIC ECKENHOFF • VESNA JEVTOVIC-TODOROVIC

##### Chapter 16

*The Autonomic Nervous System* 346

DAVID B. GLICK

##### Chapter 17

*Cerebral Physiology and the Effects of Anesthetic Drugs* 387

PIYUSH M. PATEL • JOHN C. DRUMMOND • BRIAN P. LEMKUIL

##### Chapter 18

*Neuromuscular Physiology and Pharmacology* 423

J.A. JEEVENDRA MARTYN

##### Chapter 19

*Respiratory Physiology and Pathophysiology* 444

BRIAN P. KAVANAGH • GÖRAN HEDENSTIERNA

##### Chapter 20

*Cardiac Physiology* 473

LENA S. SUN • JOHANNA SCHWARZENBERGER • RADHIKA DINAVAH

##### Chapter 21

*Gastrointestinal Physiology and Pathophysiology* 492

MATTHIAS F. STOPFKUCHEN-EVANS • SIMON GELMAN

**Chapter 22**

*Hepatic Physiology and Pathophysiology* 520  
PHILLIP S. MUSHLIN • SIMON GELMAN

**Chapter 23**

*Renal Physiology, Pathophysiology,  
and Pharmacology* 545  
DAVID McILROY • ROBERT N. SLADEN

**PART III****Anesthetic Pharmacology****Chapter 24**

*Basic Principles of Pharmacology* 590  
TAE KYUN KIM • SHINJU OBARA • KEN B. JOHNSON

**Chapter 25**

*Inhaled Anesthetics: Mechanisms of Action* 614  
MISHA PEROUANSKY • ROBERT A. PEARCE •  
HUGH C. HEMMING, JR.

**Chapter 26**

*Inhaled Anesthetic Pharmacokinetics: Uptake,  
Distribution, Metabolism, and Toxicity* 638  
STUART A. FORMAN • YUMI ISHIZAWA

**Chapter 27**

*Inhaled Anesthetics: Pulmonary Pharmacology* 670  
NEIL E. FARBER • ECKEHARD A.E. STUTH • ASTRID G. STUCKE •  
PAUL S. PAGEL

**Chapter 28**

*Inhaled Anesthetics: Cardiovascular Pharmacology* 706  
PAUL S. PAGEL • NEIL E. FARBER

**Chapter 29**

*Inhaled Anesthetics: Delivery Systems* 752  
STEVEN G. VENTICINQUE • J. JEFFREY ANDREWS

**Chapter 30**

*Intravenous Anesthetics* 821  
JAAP VUYK • ELSKE SITSSEN • MARIJE REEKERS

**Chapter 31**

*Opioid Analgesics* 864  
KAZUHIKO FUKUDA

**Chapter 32**

*Nonopioid Pain Medications* 915  
LUCY CHEN • JIANREN MAO

**Chapter 33**

*Intravenous Drug Delivery Systems* 919  
MICHEL M.R.F. STRUYS • ANTHONY R. ABSALOM •  
STEVEN L. SHAFER

**Chapter 34**

*Pharmacology of Neuromuscular Blocking Drugs* 958  
MOHAMED NAGUIB • CYNTHIA A. LIEN •  
CLAUDE MEISTELMAN

**Chapter 35**

*Reversal (Antagonism) of Neuromuscular Blockade* 995  
GLENN S. MURPHY • HANS D. DE BOER •  
LARS I. ERIKSSON • RONALD D. MILLER

**Chapter 36**

*Local Anesthetics* 1028  
CHARLES B. BERDE • GARY R. STRICHARTZ

**PART IV****Anesthesia Management****Chapter 37**

*Risk of Anesthesia* 1056  
MARK D. NEUMAN • LEE A. FLEISHER

**Chapter 38**

*Preoperative Evaluation* 1085  
DUMINDA N. WIJEYSUNDERA • BOBBIE-JEAN SWEITZER

**Chapter 39**

*Anesthetic Implications of Concurrent Diseases* 1156  
LEE A. FLEISHER • MICHAEL MYTHEN

**Chapter 40**

*Anesthetic Implications of Complementary  
and Alternative Medications* 1226  
CHONG-ZHI WANG • CHUN-SU YUAN • JONATHAN MOSS

**Chapter 41**

*Patient Positioning and Associated Risks* 1240  
LYDIA CASSORLA • JAE-WOO LEE

**Chapter 42**

*Neuromuscular Disorders and Other Genetic  
Disorders* 1266  
ALA NOZARI • ARANYA BAGCHI • RICHA SAXENA •  
BRIAN T. BATEMAN

**Chapter 43**

*Malignant Hyperthermia and Muscle-Related  
Disorders* 1287  
JIE ZHOU • DIPTIMAN BOSE • PAUL D. ALLEN • ISAAC N. PESSAH

**Chapter 44**

*Fundamental Principles of Monitoring  
Instrumentation* 1315  
JAMES SZOCIK • STEVEN J. BARKER • KEVIN K. TREMPER

**Chapter 45**

*Cardiovascular Monitoring* 1345  
REBECCA SCHROEDER • ATILIO BARBEITO •  
SHAHAR BAR-YOSEF • JONATHAN B. MARK

**Chapter 46**

*Perioperative Echocardiography* 1396  
GEORGES DESJARDINS • DANIEL P. VEZINA •  
KEN B. JOHNSON • MICHAEL K. CAHALAN

**Chapter 47**

*Electrocardiography, Perioperative Ischemia, and Myocardial Infarction* 1429

GIORA LANDESBURG • ZAK HILLEL

**Chapter 48**

*Implantable Cardiac Pulse Generators: Pacemakers and Cardioverter-Defibrillators* 1460

MARC A. ROZNER

**Chapter 49**

*Neurologic Monitoring* 1487

CHRISTOPH N. SEUBERT • MICHAEL E. MAHLA

**Chapter 50**

*Monitoring Brain State During General Anesthesia and Sedation* 1524

EMERY N. BROWN • KEN SOLT • PATRICK L. PURDON • OLUWASEUN JOHNSON-AKEJU

**Chapter 51**

*Respiratory Monitoring* 1541

HOVIG V. CHITILIAN • DAVID W. KACZKA • MARCOS F. VIDAL MELO

**Chapter 52**

*Renal Function Monitoring* 1580

KATHLEEN LIU • MARK STAFFORD-SMITH • ANDREW SHAW

**Chapter 53**

*Neuromuscular Monitoring* 1604

JØRGEN VIBY-MOGENSEN • CASPER CLAUDIUS

**Chapter 54**

*Temperature Regulation and Monitoring* 1622

DANIEL I. SESSLER

**Chapter 55**

*Airway Management in the Adult* 1647

CARIN A. HAGBERG • CARLOS A. ARTIME

**Chapter 56**

*Spinal, Epidural, and Caudal Anesthesia* 1684

RICHARD BRULL • ALAN J.R. MACFARLANE • VINCENT W.S. CHAN

**Chapter 57**

*Peripheral Nerve Blocks* 1721

TERESE T. HORLOCKER • SANDRA L. KOPP • DENISE J. WEDEL

**Chapter 58**

*Ultrasound Guidance for Regional Anesthesia* 1752

JENS KESSLER • ANDREW T. GRAY

**Chapter 59**

*Perioperative Fluid and Electrolyte Therapy* 1767

MARK R. EDWARDS • MICHAEL P.W. GROCOTT

**Chapter 60**

*Perioperative Acid-Base Balance* 1811

PATRICK J. NELIGAN • CLIFFORD S. DEUTSCHMAN

**Chapter 61**

*Patient Blood Management: Transfusion Therapy* 1830

RONALD D. MILLER

**Chapter 62**

*Patient Blood Management: Coagulation* 1868

THOMAS F. SLAUGHTER

**Chapter 63**

*Patient Blood Management: Autologous Blood Procurement, Recombinant Factor VIIa Therapy, and Blood Utilization* 1881

LAWRENCE T. GOODNOUGH • TERRI G. MONK

**VOLUME 2****PART V****Adult Subspecialty Management****Chapter 64**

*Anesthesia and Treatment of Chronic Pain* 1898

CHRISTOPH STEIN • ANDREAS KOPF

**Chapter 65**

*Palliative Medicine* 1919

SARAH GEBAUER

**Chapter 66**

*Anesthesia for Thoracic Surgery* 1942

PETER D. SLINGER • JAVIER H. CAMPOS

**Chapter 67**

*Anesthesia for Cardiac Surgical Procedures* 2007

NANCY A. NUSSMEIER • MUHAMMAD F. SARWAR • BRUCE E. SEARLES • LINDA SHORE-LESSERSON • MARC E. STONE • ISOBEL RUSSELL

**Chapter 68**

*Anesthesia for Correction of Cardiac Arrhythmias* 2096

SAMUEL A. IREFIN

**Chapter 69**

*Anesthesia for Vascular Surgery* 2106

EDWARD J. NORRIS

**Chapter 70**

*Anesthesia for Neurologic Surgery* 2158

JOHN C. DRUMMOND • PIYUSH M. PATEL • BRIAN P. LEMKUIJL

**Chapter 71**

*Anesthesia for Bariatric Surgery* 2200

DAVID M. ECKMANN

**Chapter 72**

*Anesthesia and the Renal and Genitourinary Systems* 2217

VINOD MALHOTRA • VIJAYENDRA SUDHEENDRA • JEROME O'HARA • ANUJ MALHOTRA

**Chapter 73**

*Anesthesia and the Hepatobiliary System* 2244

DAVID M. ROTHENBERG • CHRISTOPHER J. O'CONNOR • KENNETH J. TUMAN

**Chapter 74**

*Anesthesia for Abdominal Organ Transplantation* 2262  
RANDOLPH H. STEADMAN • CHRISTOPHER L. WRAY

**Chapter 75**

*Anesthesia for Organ Procurement* 2292  
VICTOR W. XIA • RANDOLPH H. STEADMAN

**Chapter 76**

*Brain Death* 2307  
KOH SHINGU • SHINICHI NAKAO

**Chapter 77**

*Anesthesia for Obstetrics* 2328  
PAMELA FLOOD • MARK D. ROLLINS

**Chapter 78**

*Anesthesia for Fetal Surgery and Other Fetal Therapies* 2359  
MARK D. ROLLINS

**Chapter 79**

*Anesthesia for Orthopedic Surgery* 2386  
MICHAEL K. URBAN

**Chapter 80**

*Geriatric Anesthesia* 2407  
FREDERICK SIEBER • RONALD PAULDINE

**Chapter 81**

*Anesthesia for Trauma* 2423  
MAUREEN MCCUNN • THOMAS E. GRISSOM • RICHARD P. DUTTON

**Chapter 82**

*Anesthesia and Prehospital Emergency and Trauma Care* 2460  
PETER NAGELE • MICHAEL HÜPFL

**Chapter 83**

*The Role of the Anesthesia Provider in Natural and Human-Induced Disasters* 2479  
DAVID J. BAKER

**Chapter 84**

*Anesthesia for Eye Surgery* 2512  
MARC ALLAN FELDMAN

**Chapter 85**

*Anesthesia for Ear, Nose, and Throat Surgery* 2523  
D. JOHN DOYLE

**Chapter 86**

*Administration of Anesthesia by Robots* 2550  
THOMAS M. HEMMERLING

**Chapter 87**

*Anesthesia for Robotically Conducted Surgery* 2581  
SUMEET GOSWAMI • PRIYA A. KUMAR • BEREND METS

**Chapter 88**

*Anesthesia for Laser Surgery* 2598  
VICKI E. MODEST • PAUL H. ALFILLE

**Chapter 89**

*Ambulatory (Outpatient) Anesthesia* 2612  
IAN SMITH • MARK SKUES • BEVERLY K. PHILIP

**Chapter 90**

*Non-Operating Room Anesthesia* 2646  
WENDY L. GROSS

**Chapter 91**

*Clinical Care in Extreme Environments: At High and Low Pressure and in Space* 2674  
RICHARD E. MOON • ENRICO M. CAMPORESI

**PART VI**

**Pediatric Anesthesia**

**Chapter 92**

*Regional Anesthesia in Children* 2706  
CHRISTOPHE DADURE • CHRYSTELLE SOLA • BERNARD DALENS • XAVIER CAPDEVILA

**Chapter 93**

*Pediatric Anesthesia* 2757  
CHARLES J. COTÉ

**Chapter 94**

*Anesthesia for Pediatric Cardiac Surgery* 2799  
WILLIAM J. GREELEY • CHAD C. CRIPE • ARUNA T. NATHAN

**Chapter 95**

*Pediatric and Neonatal Intensive Care* 2854  
TODD J. KILBAUGH • MAURICE ZWASS • PATRICK ROSS

**PART VII**

**Postoperative Care**

**Chapter 96**

*The Postanesthesia Care Unit* 2924  
THEODORA KATHERINE NICHOLAU

**Chapter 97**

*Postoperative Nausea and Vomiting* 2947  
CHRISTIAN C. APFEL

**Chapter 98**

*Acute Postoperative Pain* 2974  
ROBERT W. HURLEY • JAMIE D. MURPHY • CHRISTOPHER L. WU

**Chapter 99**

*Cognitive Dysfunction and Other Long-term Complications of Surgery and Anesthesia* 2999  
LARS S. RASMUSSEN • JAN STYGALL • STANTON P. NEWMAN

**Chapter 100**

*Postoperative Visual Loss* 3011  
STEVEN ROTH

**PART VIII****Critical Care Medicine****Chapter 101**

*Critical Care Anesthesiology* 3034  
LINDA L. LIU • MICHAEL A. GROPPER

**Chapter 102**

*Critical Care Protocols and Decision Support* 3054  
BENJAMIN A. KOHL • C. WILLIAM HANSON

**Chapter 103**

*Respiratory Care* 3063  
SALVATORE GRASSO • LUCIANA MASCIA • V. MARCO RANIERI

**Chapter 104**

*Nitric Oxide and Other Inhaled Pulmonary Vasodilators* 3084  
FUMITO ICHINOSE • WARREN M. ZAPOL

**Chapter 105**

*Neurocritical Care* 3098  
MICHAEL J. SOUTER • ARTHUR M. LAM

**Chapter 106**

*Nutrition and Metabolomics* 3121  
CHARLES WEISSMAN

**Chapter 107**

*Extracorporeal Support Therapies* 3158  
ZACCARIA RICCI • STEFANO ROMAGNOLI • CLAUDIO RONCO

**Chapter 108**

*Cardiopulmonary Resuscitation: Basic and Advanced Life Support* 3182  
BRIAN P. McGLINCH • ROGER D. WHITE

**PART IX****Ancillary Issues and Responsibilities****Chapter 109**

*Electrical Safety in the Operating Room* 3218  
LAWRENCE LITT

**Chapter 110**

*Environmental Safety and Chemical Dependency* 3231  
THEODORA KATHERINE NICHOLAU • CHRISTOPHER G. CHOUKALAS

**Chapter 111**

*Statistical Methods in Anesthesia* 3247  
STANLEY H. ROSENBAUM

**Chapter 112**

*Evaluation and Classification of Evidence for the ASA Clinical Practice Guidelines* 3257  
RICHARD T. CONNIS • DAVID G. NICKINOVICH • ROBERT A. CAPLAN • JEFFREY L. APFELBAUM