

# Essentials of Regional Anesthesia

*Second Edition*

Alan David Kaye  
Richard D. Urman  
Nalini Vadivelu  
*Editors*

 Springer

**EXTRAS ONLINE**

---

# Essentials of Regional Anesthesia

---

Alan David Kaye • Richard D. Urman  
Nalini Vadivelu  
Editors

# Essentials of Regional Anesthesia

Second Edition

 Springer

*Editors*

Alan David Kaye, MD, PhD  
Department of Anesthesiology  
Louisiana State University School  
of Medicine  
New Orleans, LA  
USA

Richard D. Urman, MD, MBA, FASA  
Department of Anesthesiology  
Perioperative and Pain Medicine  
Brigham and Women's Hospital  
Boston, MA  
USA

Nalini Vadivelu, MBBS, MD, DNB  
Department of Anesthesiology  
Yale University School of Medicine  
New Haven, CT  
USA

Electronic Supplementary Material can be downloaded from <https://link.springer.com/book/10.1007/978-3-319-74838-2>

ISBN 978-3-319-74837-5      ISBN 978-3-319-74838-2 (eBook)  
<https://doi.org/10.1007/978-3-319-74838-2>

Library of Congress Control Number: 2018936917

© Springer International Publishing AG, part of Springer Nature 2012, 2018

This work is subject to copyright. All rights are reserved by the Publisher, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, reuse of illustrations, recitation, broadcasting, reproduction on microfilms or in any other physical way, and transmission or information storage and retrieval, electronic adaptation, computer software, or by similar or dissimilar methodology now known or hereafter developed.

The use of general descriptive names, registered names, trademarks, service marks, etc. in this publication does not imply, even in the absence of a specific statement, that such names are exempt from the relevant protective laws and regulations and therefore free for general use.

The publisher, the authors and the editors are safe to assume that the advice and information in this book are believed to be true and accurate at the date of publication. Neither the publisher nor the authors or the editors give a warranty, express or implied, with respect to the material contained herein or for any errors or omissions that may have been made. The publisher remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Printed on acid-free paper

This Springer imprint is published by the registered company Springer International Publishing AG part of Springer Nature  
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

*For my wife Kim Kaye, M.D.,  
for her patience, love, and wisdom  
in raising our two wonderful children,  
Aaron and Rachel.*

Alan David Kaye

*For my mentors, students, and trainees  
for their inspiration; my parents,  
Dennis and Tanya; my wife,  
Zina Matlyuk-Urman, M.D.; and my children,  
Abigail and Isabelle.*

Richard D. Urman

*For my parents;  
my husband, Muthu; my sons, Gopal  
and Vijay; and all my colleagues and friends  
for their constant encouragement.*

Nalini Vadivelu

---

## Foreword

It is an enormous honor to pen this Foreword to *Essentials of Regional Anesthesia* in light of my following in the footsteps of the inimitable Professor P. Prithvi Raj, the author of the last edition's opening statement. In that regard alone, I am humbled to be next in line to comment upon the value of this extremely timely addition to our regional anesthesia armamentarium, which presents a fresh look at the evolving and expanding world of regional anesthesia.

I became immersed in the world of regional anesthesia when I sat in on Dr. Alon Winnie's address to the American Society of Anesthesiologist's Annual Meeting detailing his unique perspective on brachial plexus anesthesia in the early 1980s. Until that time there were only two regional anesthesia textbooks in common usage by clinicians, *Regional Block* by Dr. Daniel C. Moore from the Virginia Mason Medical Center in Seattle and *Neural Blockade, Pain Management* by Dr. Phil Bridenbaugh from Cincinnati along with Dr. Michael Cousins from Australia. From the moment I listened to Dr. Winnie and going forward I knew that there was no greater application of art to science in all of medicine than that presented by the challenge of providing discrete, localized, and well-circumscribed neural blockade to isolated areas of the body without engendering the trespass associated with use of general anesthesia, which up to that time continued to have a somewhat prohibitive incidence of grave consequences associated with its use. Coincidentally, while general anesthesia was about to become conspicuously safer with the advent and routine use of capnography and pulse oximetry, paradoxically instead of relegating regional anesthesia to the wayside, the popularity and utility of regional soared in the 1980s and beyond. This coincided with its own renaissance of sorts, including the practical identification that sound waves directed at a target or bundle of nerves while performing a block could enhance safety and efficacy of the procedures. In addition to safety and efficacy, ultrasound guidance empowered the meek and timid, who previously would have avoided regional block at all costs, and changed regional anesthesia from being a formidable and exclusionary practice limited to a mere few experts, to a practice that could be readily handed down from mentor to mentee with little fanfare and with extremely shallow learning curves. This is true particularly when contemporary training in regional is compared to the regional block training of the past, which relied heavily upon mastery of oftentimes imprecise percutaneous landmarks and the uncertainties of electrical neural stimulation.

Alon Winnie, like Prithvi Raj, was part of the renaissance of regional anesthesia, when in 1975 they partnered (along with Harold Carron, L. Donald Bridenbaugh, Jordan Katz) to resurrect the long-defunct American Society of Regional Anesthesia (ASRA; now known as the American Society of Regional Anesthesia and Pain Medicine), in anticipation of the resurgence of interest in regional anesthesia and pain management, recognizing that the two concepts are conjoined twins and always have been. It is no surprise and no coincidence that the great leaders of regional anesthesia have been and likely always will be experts at both pain management and in regional peripheral and neuraxial blockade. In that regard, Drs. Winnie and Raj; John Bonica and Daniel Moore; Gabor Racz and Steve Waldman; Michael Cousins and Phillip Bridenbaugh, among others, have each been considered to be world leaders not only in the domains of regional anesthesia but also in the management of acute and chronic pain conditions.

In 1999, while authoring a textbook chapter with Dr. Winnie for a novel text, *Pain Management and Regional Anesthesia in Trauma*, I was intrigued to note that Alon had included eight “postulates” concerning regional anesthesia and the expected benefits of peripheral nerve blocks, particularly when compared to use of general anesthesia or central neuraxial (spinal and epidural) types of blocks. Among his statements touting the major advantages of regional, he stated that it would...

- Provide Superior Postoperative Analgesia to Oral or IV Opioid Analgesics
- Improve Rehabilitation Efforts (due to analgesia)
- Lead to Decreased Perioperative Nausea and Vomiting (Less Opioid Use)
- Provide for Faster Emergence and Recovery
- Encourage Earlier Mobilization (Unilateral Block)
- Unilateral, Postganglionic Sympathetic Block with Less Associated Trespass
- Contribute to Faster Outpatient Discharge
- Have Extended Benefits via Continuous Catheters

In 1999, I was hesitant to include these bold statements into the body of a work which would be widely accessible to the masses and which would contribute to our enduring materials on regional anesthesia. Nevertheless, as usual he prevailed, and the result was that each and every one of these prescient proclamations of his did indeed come to fruition over time, affirming that this regional anesthesia business was “no humbug” indeed!

The use of regional anesthesia has become a centerpiece in our war against overuse of opioid analgesics. Providing profound analgesia to our patients reduces their need for consuming narcotics while also helping them bridge the time from surgical or procedural trespass to the safety of their homes. There is an abundance of clinical and experimental evidence available that unequivocally demonstrates these essential attributes of these techniques and which is a furtherance that opioid sparing, a mandate that all practicing clinicians must confront, can reasonably and reliably be accomplished by the use of regional block techniques using local anesthetics with and without adjunctive medications.

The present reference work is an affirmation of the concepts established long ago by the great leaders of regional anesthesia which has been succinctly presented in a manner most conducive to enhancing the educational process. Carefully organized into eight sections and expanded from the previous edition's 31 chapters to 39 chapters, this reference work should become a compulsory reading for anyone interested in expanding their horizons on all topics related to regional anesthesia, including basic and advanced constructs and incorporating the most up-to-date issues confronting those engaging in regional anesthesia practice. Among these are the considerations related to anticoagulation use; use of regional in acute settings such as the trauma patient; preemptive analgesia and the prevention of chronic postoperative pain; and the newer and more novel techniques of regional block popularized by the expansion of anatomical principles identified with the veritable explosion in ultrasound use.

Dr. Alan David Kaye has followed the pathways blazed by our great forefathers in combining his passions for pain management with those of regional anesthesia. After all, the lessons of the past have been transmitted to him through his unrivaled mentoring at the hands of Professors Racz and Raj, among others. These lessons permeate throughout this unique reference work, and whether the reader is a true regional anesthesia expert, is a first-time novice intent on becoming a master, or is merely a curious scopophiliac who wishes to expand their horizons, this book will provide a wonderful passageway to accomplishing these goals. With great pride, I too have made my humble contributions, and look upon this task as a most joyous triumph of scholastic achievement.

Chicago, IL, USA

Kenneth D. Candido, MD



---

## Preface

We are proud to present this updated 2nd edition of our popular practical guide to regional anesthesia techniques. The practice of regional anesthesia has undergone tremendous evolution in the past few decades. Until recently, older “blind” techniques were taught, and successful regional anesthetics were typically limited to a few extraordinary clinicians in each department of anesthesia worldwide. Ultrasound, electrical stimulation, fluoroscopy, and continuous catheters have contributed to a revolution in the fields of regional anesthesia and pain management. Advances in technology have changed these fields significantly, resulting in the development of formal regional anesthesia and pain fellowships. In addition, there is an increasing emphasis on regional anesthesia techniques for acute pain control in order to promote better patient outcomes.

The present field of regional anesthesia has challenged not only new residents and fellows but also older practicing anesthesiologists and other specialists to learn these new techniques and technologies in their clinical practices. Excellence and versatility in regional anesthesia can provide the means by which we better manage acute and chronic pain. Modern regional anesthesia provides hope and optimism for the comfort of future generations of patients afflicted with a wide array of medical conditions.

One of the strategies in creating this updated, evidence-based 2nd edition of *Essentials of Regional Anesthesia* was to make it practical for the clinician. To that end, we have recruited regional anesthesia experts, as well as fellowship directors and their fellows, as authors for most of the chapters in this book. We also requested that authors identify clinical pearls and help us create a databank of questions for trainees to facilitate learning of the subject material. The editors of the book agree that this has been a challenging but rewarding project. As with the first edition, we have endeavored to present the material with clarity and conciseness. Our goal has been a book of practical applicability for the anesthesia provider and others who would like to learn more about the field. Best of luck to each of you as you develop your clinical practices in regional anesthesia.

New Orleans, LA, USA  
Boston, MA, USA  
New Haven, CT, USA

Alan David Kaye  
Richard D. Urman  
Nalini Vadivelu

---

# Contents

## **Part I General Principles of Regional Anesthesia Practice**

- 1 General Considerations for Regional Anesthesia Practice . . . . . 3**  
Svetla Kurteva, Iyabo Olubunmi Muse, and Karina Gritsenko
- 2 Economic Impact, Cost, and Reimbursement Issues . . . . . 21**  
Deepti Agarwal and Maunak V. Rana
- 3 Training and Education of a Physician for  
Regional Anesthesia . . . . . 35**  
Chris M. Farlinger and Jonathan C. Beathe

## **Part II Basics and Clinical Practice in Regional Anesthesia**

- 4 The Anatomy of Pain and Its Implications for Regional  
Anesthesiology Practice . . . . . 53**  
Harry J. Gould III and Alan David Kaye
- 5 Local Anesthetics and Adjuvants . . . . . 83**  
Francesco Vetri, Jose A. Aguirre, Effrossyni G. Votta-Velis,  
and Alain Borgeat
- 6 Monitoring and Sedation in Regional Anesthesia . . . . . 107**  
James Kim and Jeff Gadsden
- 7 Anticoagulation and Regional Anesthesia Concerns . . . . . 121**  
Alan David Kaye, Thomas Ngo Trang, Elyse M. Cornett,  
Ken Philip Ehrhardt Jr, and Rinoo Vasant Shah
- 8 Regional Anesthesia in the Community Practice Setting . . . . . 135**  
Joseph Marino and Brian E. Harrington

## **Part III Ultrasound-Assisted Nerve Blocks**

- 9 Ultrasound-Guided Peripheral Nerve Blockade . . . . . 171**  
Alan Bielsky and David M. Polaner

## **Part IV Continuous Regional Analgesia and Techniques for Regional Anesthesia**

- |           |  |     |
|-----------|--|-----|
| <b>10</b> | <b>Equipment and Clinical Practice: Aids to Localization of Peripheral Nerves</b> . . . . .                                      | 201 |
|           | Bryan Tischenkel, Beverly Pearce-Smith, Johnny K. Lee, and Karina Gritsenko  |     |
| <b>11</b> | <b>Neuraxial Blockade: Subarachnoid Anesthesia</b> . . . . .   | 213 |
|           | Maria Teresa Gudin, Ramón López-Vicente, Esperanza Ortigosa, María Del Mar Caro Cascante, Carmen Garcia Molina, and Sonia Martin |     |
| <b>12</b> | <b>Neuraxial Blockade: Epidural Anesthesia</b> . . . . .   | 233 |
|           | Sreekumar Kunnumpurath, Suneil Ramessur, Adam Fendius, Nalini Vadivelu, and Jasmina Perinpanayagam                               |     |
| <b>13</b> | <b>Peripheral Nerve Blocks for the Lower Extremity</b> . . . . .   | 265 |
|           | Sylvia H. Wilson and Anna Uskova   |     |
| <b>14</b> | <b>Regional and Topical Anesthesia for Endotracheal Intubation</b> . . . . .   | 281 |
|           | Ryan Philip Ellender, Shilpadevi S. Patil, Lien Tran, Scott M. Kleinpeter, Elyse M. Cornett, and Alan David Kaye                 |     |
| <b>15</b> | <b>Regional Anesthetic Techniques for the Pediatric Patient</b> . . . . .  | 297 |
|           | Vaughn E. Nossaman and Bobby D. Nossaman   |     |
| <b>16</b> | <b>Head and Neck Regional Anesthesia</b> . . . . .   | 317 |
|           | Desiree Persaud and Sébastien Garneau  |     |
| <b>17</b> | <b>Upper Extremity Nerve Blocks</b> . . . . .  | 331 |
|           | De Q. H. Tran, Maria Francisca Elgueta, and Juan Francisco Asenjo  |     |
| <b>18</b> | <b>Local Anesthesia of the Masticatory Region</b> . . . . .  | 357 |
|           | Henry A. Gremillion, Christopher J. Spencer, Alex D. Ehrlich, and Janice A. Townsend   |     |
| <b>19</b> | <b>Regional Anesthetic Techniques for Foot Surgery</b> . . . . .   | 375 |
|           | Rick C. Chen and Peter A. Blume  |     |
| <b>20</b> | <b>Selective Regional Anesthesia Options in Surgical Subspecialties</b> . . . . .  | 387 |
|           | Hong Yan, Alan David Kaye, and Henry Liu   |     |
| <b>21</b> | <b>Obstetric Anesthesiology</b> . . . . .  | 397 |
|           | Debbie Chandler, Ray Paschall, Leslie Robichaux, Burton Beakley, Elyse M. Cornett, and Alan David Kaye                           |     |
| <b>22</b> | <b>Acute Situations: Trauma in Surgical Specialties</b> . . . . .  | 431 |
|           | Sandra Giannone, Daniela Ghisi, Andrea Fanelli, and Carl C. Rest   |     |

<b>23</b>	<b>Preemptive Analgesia, Regional Anesthesia, and Prevention of Chronic Postoperative Pain</b> . . . . .	<b>445</b>
	Erik M. Helander, Jonathan P. Eskander, Christina L. Juneau, Matthew B. Novitch, Amit Prabhakar, Amy M. DeKerlegand, Elyse M. Cornett, and Alan David Kaye	
<b>24</b>	<b>Transverse Abdominal Plane, Pectoral and Serratus Plane, and Quadratus Lumborum Blocks</b> . . . . .	<b>463</b>
	Rita Merman, Vladislav Shick, and Vikram Bhasin	
<b>Part V Regional Anesthesia and Subspecialties</b>		
<b>25</b>	<b>Outpatient Surgery</b> . . . . .	<b>473</b>
	Kelly R. Mercer	
<b>26</b>	<b>Regional Anesthesia in the Critical Care Setting</b> . . . . .	<b>481</b>
	Amir O. Elhassan, Harish Bangalore Siddaiah, Brendon M. Hart, Mark Ryan Jones, Cory A. Roberts, Maura Elise Jones, and Alan David Kaye	
<b>Part VI Regional Anesthesia for Chronic Situations</b>		
<b>27</b>	<b>Regional Anesthesia for Chronic Pain</b> . . . . .	<b>491</b>
	Neil Malhotra, Vijay Krishnamoorthy, Effrossyni G. Votta-Velis, and Alain Borgeat	
<b>28</b>	<b>Regional Anesthesia Considerations for Chronic Noncancer Pain</b> . . . . .	<b>503</b>
	Lauren K. Eng, Lindsey K. Okada, and Matthew R. Eng	
<b>29</b>	<b>Malignant Pain</b> . . . . .	<b>509</b>
	Kenneth D. Candido and Teresa M. Kuser	
<b>30</b>	<b>Regional Anesthesia and Cardiovascular Disease</b> . . . . .	<b>529</b>
	Veerandra Koyyalamudi, Lien Tran, Camellia D. Asgarian, Molly Kraus, Zacherie Conover, Jeremy Alvord, Elyse M. Cornett, and Alan David Kaye	
<b>31</b>	<b>Regional Anesthesia in the Patient with Preexisting Neurological Disease</b> . . . . .	<b>541</b>
	Rafael Justiz and Alexander F. Bautista	
<b>32</b>	<b>Sympathetic Blockade</b> . . . . .	<b>555</b>
	Miles Day, Rafael Justiz, Audra Day, and Maxim S. Eckmann	
<b>Part VII Outcomes Studies in Regional Anesthesia</b>		
<b>33</b>	<b>Outcome Studies and Infection Control in Regional Anesthesia</b> . . . . .	<b>589</b>
	Joshua Ryan Dooley and Stuart Alan Grant	

---

**34 Acute Pain Management** ..... 617  
Alan David Kaye, Brooke V. Towne, Vibhav B. Reddy,  
Michael F. Kelley Jr, Si Zhang, Lien Tran, Elyse M. Cornett,  
and Ralf E. Gebhard

**35 Regional Anesthesia for Chronic Disease States** ..... 637  
Siamak Rahman and Parisa Partownavid

**36 Intravenous Regional Anesthesia** ..... 649  
Lindsey Vokach-Brodsky, Vibhav B. Reddy, Kathryn Teixeira,  
Elyse M. Cornett, Julie Gayle, Patricia B. Sutker,  
and Alan David Kaye

**37 Pediatric Pain** ..... 655  
Lori-Ann Oliver, Jodi-Ann Oliver, Hassan Rayaz,  
and J. Lance Lichtor

**Part VIII Future Trends in Regional Anesthesia**

**38 Future Trends in Equipment** ..... 685  
Neda Sadeghi and Jeff Gadsden

**39 Future Trends in Regional Anesthesia Techniques** ..... 695  
Amanda Kumar and Jeff Gadsden

**Index** ..... 705

---

## Contributors

**Deepti Agarwal, MD** Department of Anesthesiology, Advocate Illinois Masonic Medical Center, Chicago, IL, USA

**Jose A. Aguirre, MD, MSc** Division of Anesthesiology, Balgrist University Hospital, Zurich, Switzerland

**Jeremy Alvord, MD** Department of Anesthesiology, Mayo Clinic AZ, Phoenix, AZ, USA

**Juan Francisco Asenjo, MD, FRCPC** Department of Anesthesia and Pain Medicine, McGill University, Montreal, QC, Canada

**Camellia D. Asgarian, MD** Department of Anesthesiology, Louisiana State University, New Orleans, LA, USA

**Alexander F. Bautista, MD** Department of Anesthesiology and Pain Medicine, University of Oklahoma Health Sciences Center, Oklahoma City, OK, USA

**Burton Beakley, MD** Department of Anesthesia, Tulane University, New Orleans, LA, USA

**Jonathan C. Beathe, MD** Department of Anesthesiology, Hospital for Special Surgery, Weill Cornell Medical College, New York, NY, USA

**Vikram Bhasin, MD** Regional Anesthesiology and Acute Pain Medicine, Department of Anesthesiology, University of Pittsburgh Medical Center, Pittsburgh, PA, USA

**Alan Bielsky, MD** Department of Anesthesiology, University of Colorado School of Medicine, Children's Hospital Colorado, Aurora, CO, USA

**Peter A. Blume, DPM, FACFAS** Affiliated Foot and Ankle Surgeons PC, Yale New Haven Hospital, New Haven, CT, USA

**Alain Borgeat, MD** Department of Anesthesiology, Balgrist University Hospital, Zurich, Switzerland

**Kenneth D. Candido, MD** Department of Anesthesiology, Advocate Illinois Masonic Medical Center, Chicago, IL, USA

Departments of Surgery and Anesthesiology, University of Illinois College of Medicine, Chicago, IL, USA

**María Del Mar Caro Cascante, MD** Department of Anesthesiology and Critical Care Medicine, Getafe University Hospital, Madrid, Spain

**Debbie Chandler, MD** Perioperative Services, Pediatric Anesthesia, Department of Anesthesiology, Louisiana State University Health Sciences Center—Shreveport, Shreveport, LA, USA

**Rick C. Chen, DPM** Family Foot and Ankle Physicians, Greenville, NC, USA

**Zacherie Conover, MD** Anesthesiology, Mayo Clinic, Phoenix, AZ, USA

**Elyse M. Cornett, PhD** Department of Anesthesiology, Louisiana State University Health Sciences Center—Shreveport, Shreveport, LA, USA

**Audra Day, PhD** Kinesiology and Sports Management, Texas Tech University, Lubbock, TX, USA

**Miles Day, MD** Department of Anesthesiology, Texas Tech University Health Sciences Center, Lubbock, TX, USA

**Amy DeKerlegand, BS** School of Medicine, Louisiana State University Health Sciences Center—New Orleans, New Orleans, LA, USA

**Joshua Ryan Dooley, MD** Department of Anesthesiology, Duke University, Durham, NC, USA

**Maxim S. Eckmann, MD** Department of Anesthesiology, UT Health San Antonio, San Antonio, TX, USA

**Ken Philip Ehrhardt Jr, MD** Department of Anesthesia, Louisiana State University Medical Center, New Orleans, LA, USA

**Alex D. Ehrlich, DDS, MS** Department of Comprehensive Dentistry and Biomaterials, Louisiana State University Health Sciences Center School of Dentistry, LSU School of Dentistry, New Orleans, LA, USA

**Amir O. Elhassan, MD** Department of Anesthesiology, Ohio State University, Wexner Medical Center, Dublin, OH, USA

**Ryan Philip Ellender, MD** Anesthesiology, Hilton Head Regional Healthcare, Hilton Head Island, SC, USA

**Lauren K. Eng** Tulane University School of Medicine, New Orleans, LA, USA

**Matthew R. Eng, MD** Department of Anesthesiology, Baylor University Medical Center, Dallas, TX, USA

**Jonathan P. Eskander, MD, MBA** Department of Anesthesiology, University Health, Shreveport, LA, USA

**Andrea Fanelli, MD** Department of Anesthesiology and Pain Management, Policlinico Sant'Orsola-Malpighi, Bologna, Italy

**Chris M. Farlinger, MD, MSc, FRCPC** Department of Anesthesiology, Hospital for Special Surgery, Weill Cornell Medical College, New York, NY, USA

**Adam Fendius, MBBS, BSc(Hons), DipIMC, FRCA** Anaesthesia, Oxford University Hospitals NHS Foundation Trust, Oxford, Oxfordshire, UK

**Jeff Gadsden, MD, FRCPC, FANZCA** Department of Anesthesiology, Duke University Medical Center, Durham, NC, USA

**Sébastien Garneau, MD, DMV, FRCPC** Department of Anesthesiology, Centre Hospitalier de l'Université de Montréal, Montreal, QC, Canada

**Julie Gayle, MD** Department of Anesthesiology, Louisiana State University Health Sciences Center, New Orleans, LA, USA

**Ralf E. Gebhard, MD** Department of Anesthesiology, University of Miami-Miller School of Medicine, Miami, FL, USA

**Daniela Ghisi, MD** Department of Anesthesia, Intensive Care and Pain Therapy, Istituto Ortopedico Rizzoli, Bologna, Italy

**Sandra Giannone, MD** Department of Anesthesia, Intensive Care and Pain Management, Rizzoli Orthopedic Institute, Bologna, Italy

**Harry J. Gould III, MD, PhD** Neurology and Neuroscience, Louisiana State University Health Sciences Center—New Orleans, New Orleans, LA, USA

**Stuart Alan Grant, MB, ChB, MMCI, FRCA** Department of Anesthesiology, Duke University, Durham, NC, USA

**Henry A. Gremillion, DDS, MAGD** Department of Orthodontics, Louisiana State University Health Sciences Center School of Dentistry, LSU School of Dentistry, New Orleans, LA, USA

**Karina Gritsenko, MD** Regional Anesthesia and Acute Pain Medicine, Department of Anesthesiology, Montefiore Medical Center—Albert Einstein College of Medicine, Bronx, NY, USA

**Maria Teresa Gudín, MD** Department of Anesthesiology and Critical Care Medicine, Getafe University Hospital, Madrid, Spain

**Brian E. Harrington, MD** Anesthesiology, Billings Clinic Hospital, Billings, MT, USA

**Brendon M. Hart, DO** Department of Anesthesiology, Louisiana State University Health Sciences Center—Shreveport, Shreveport, LA, USA

**Erik M. Helander, MBBS** Department of Anesthesiology, Louisiana State University—New Orleans, New Orleans, LA, USA

**Mark Ryan Jones, MD** Department of Anesthesiology, Critical Care and Pain Medicine, Beth Israel Deaconess Medical Center, Harvard Medical School, Boston, MA, USA

**Maura Elise Jones, BS** School of Medicine/Anesthesiology, Louisiana State University Health Sciences Center—New Orleans, New Orleans, LA, USA



**Christina L. Juneau, BSc** Department of Anesthesia, Louisiana State University Health Sciences Center, New Orleans, LA, USA

**Rafael Justiz, MD** Oklahoma Pain Physicians, Oklahoma City, OK, USA  
Department of Anesthesiology, University of Oklahoma Health Sciences Center, Oklahoma City, OK, USA

**Alan David Kaye, MD, PhD** Department of Anesthesiology, Louisiana State University School of Medicine, New Orleans, LA, USA

**Michael F. Kelley Jr, BS** Department of Medicine, Louisiana State University Health Sciences Center—New Orleans, New Orleans, LA, USA

**James Kim, MD** Anesthesiology, Duke University Medical Center, Durham, NC, USA

**Scott M. Kleinpeter, BSE** Department of Medicine, Louisiana State University Health Sciences Center—New Orleans, New Orleans, LA, USA

**Veerandra Koyyalamudi, MD, MBBS** Department of Anesthesiology and Perioperative Medicine, Mayo Clinic Arizona, Phoenix, AZ, USA

**Molly Kraus, MD** Anesthesiology, Mayo Clinic Hospital, Phoenix, AZ, USA

**Vijay Krishnamoorthy, MD** Department of Anesthesiology, University of Washington, Seattle, WA, USA

**Amanda Kumar, MD** Department of Anesthesiology, Duke University Medical Center, Durham, NC, USA

**Sreekumar Kunnumpurath, MBBS, MD, FRCA, FFPMRCA** Pain Management, Epsom and St. Helier University Hospitals NHS Trust, Carshalton, UK

**Svetla Kurteva, MD** Department of Anesthesiology, Montefiore Medical Center, Bronx, NY, USA

**Teresa M. Kusper, DO** Department of Anesthesiology, Advocate Illinois Masonic Medical Center, Chicago, IL, USA

**Maria Francisca Elgueta, MD** Department of Anesthesia, Pontificia Universidad Católica de Chile, Santiago, Metropolitana, Chile

**Johnny K. Lee, MD** Department of Anesthesiology, NorthShore University Health System, Chicago, IL, USA

**J. Lance Lichtor, MD** Department of Anesthesiology, Yale University School of Medicine, New Haven, CT, USA

**Henry Liu, MD** Department of Anesthesiology and Perioperative Medicine, Hahnemann University Hospital, Drexel University College of Medicine, Philadelphia, PA, USA

**Ramón López-Vicente, MD** Department of Anesthesiology and Critical Care Medicine, Doce de Octubre Hospital, Madrid, Spain

**Neil Malhotra, MD** Department of Anesthesiology, University of Illinois Medical Center, Chicago, IL, USA

**Joseph Marino, MD** Anesthesiology, Long Island Jewish Valley Stream, Greenlawn, NY, USA

**Sonia Martin, MD** Department of Anesthesiology and Critical Care Medicine, Getafe University Hospital, Madrid, Spain

**Kelly R. Mercer, MD, CMQ** UAB Department of Anesthesiology and Perioperative Medicine, University of Alabama Hospital, Birmingham, AL, USA

**Rita Merman, MD** Department of Anesthesiology, University of Pittsburgh Medical Center, Pittsburgh, PA, USA

**Carmen Garcia Molina, MD** Department of Anesthesiology and Critical Care, University of Getafe, Madrid, Spain

**Iyabo Olubunmi Muse, MD** Department of Anesthesiology, Montefiore Medical Center, Albert Einstein College of Medicine, Bronx, NY, USA

**Bobby D. Nossaman, MD** Department of Anesthesiology, Ochsner Medical Center, New Orleans, LA, USA

**Vaughn E. Nossaman, MD** Department of Surgery, Nassau University Medical Center, East Meadow, NY, USA

**Matthew B. Novitch, MS** Neuroscience, Medical College of Wisconsin, University of Minnesota, Wausau, WI, USA

**Lindsey K. Okada, BS Biochem** Department of Neuroscience, University of Southern California, Los Angeles, CA, USA

**Jodi-Ann Oliver, MD** Department of Anesthesiology, Yale New Haven Hospital, Yale University School of Medicine, New Haven, CT, USA

**Lori-Ann Oliver, MD** Anesthesiology, Yale New Haven Hospital, Yale University School of Medicine, New Haven, CT, USA

**Esperanza Ortigosa, MD** Department of Anesthesiology and Critical Care Medicine, Getafe University Hospital, Madrid, Spain

**Parisa Partownavid, MD** Anesthesiology and Perioperative Medicine, UCLA Ronald Reagan Medical Center, Los Angeles, CA, USA

**Ray Paschall, MD, MS** Division of Obstetric Anesthesiology, Department of Anesthesiology, Vanderbilt University Medical Center, Nashville, TN, USA

**Shilpadevi S. Patil, MD** Anesthesiology and Critical Care Medicine, Louisiana State University Health Sciences Center—Shreveport, Shreveport, LA, USA

**Beverly Pearce-Smith, MD** Department of Anesthesiology, Presbyterian University Hospital, University of Pittsburgh Medical Center, Pittsburgh, PA, USA

**Jasmina Perinpanayagam, BSc(Hons), MBBS, FRCA** Anaesthetics, Epsom & St. Helier University Hospitals, Carshalton, UK

**Desiree Persaud, BSc, MD, FRCPC** Department of Anesthesiology and Pain Medicine, University of Ottawa, Ottawa, ON, Canada

**David M. Polaner, MD, FAAP** Departments of Anesthesiology and Pediatrics, University of Colorado School and Children's Hospital Colorado of Medicine, Aurora, CO, USA

**Amit Prabhakar, MD, MS** Anesthesiology and Critical Care Medicine, Johns Hopkins Hospital, Baltimore, MD, USA

**Siamak Rahman, MD** Anesthesiology and Perioperative Medicine, UCLA Ronald Reagan Medical Center, Los Angeles, CA, USA

**Suneil Ramessur, MBBS, BSc(Hons), FRCA, FFPMRCA** Anaesthetics, Guys and St. Thomas' NHS Foundation Trust, London, UK

**Maunak V. Rana, MD** Department of Anesthesiology and Critical Care, The University of Chicago, Chicago, IL, USA

**Hassan Rayaz, MD** Department of Anesthesiology, Yale University School of Medicine, New Haven, CT, USA

**Vibhav B. Reddy, MD** Department of Anesthesiology, Tulane University, New Orleans, LA, USA

**Carl C. Rest, MD** Department of Anesthesia and AIPPS, University of Pittsburgh Medical Center, Pittsburgh, PA, USA

**Cory A. Roberts, MD** Department of Anesthesia, Tulane University, New Orleans, LA, USA

**Leslie Robichaux, MD** Department of Anesthesiology, Louisiana State University Health Sciences Center—Shreveport, Shreveport, LA, USA

**Neda Sadeghi, MD** Department of Anesthesiology, Duke University Medical Center, Durham, NC, USA

**Rinoo Vasant Shah, MD, MBA** Department of Anesthesiology, Louisiana State University Health Sciences Center—Shreveport, Shreveport, LA, USA

**Vladislav Shick, MD** Acute Pain, Department of Anesthesiology, University of Pittsburgh Medical Center Mercy, Pittsburgh, PA, USA

**Harish Bangalore Siddaiah, MD** Department of Anesthesiology and Critical Care Medicine, Louisiana State University Health Sciences Center—Shreveport, Shreveport, LA, USA

**Christopher J. Spencer, DDS** Department of Diagnostic Sciences, Louisiana State University Health Sciences Center School of Dentistry, LSU School of Dentistry, New Orleans, LA, USA

**Patricia B. Sutker, PhD** Department of Anesthesiology, Louisiana State University Health Sciences Center, New Orleans, LA, USA

**Kathryn Teixeira, MD** Department of Anesthesiology, Tulane University Medical Center, New Orleans, LA, USA

**Bryan Tischenkel, MD** Department of Anesthesiology, Montefiore Medical Center, Bronx, NY, USA

**Brooke V. Towne, BA** School of Medicine, Louisiana State University Health Sciences Center—New Orleans, New Orleans, LA, USA

**Janice A. Townsend, DDS, MS** Department of Pediatric Dentistry, Louisiana State University Health Sciences Center School of Dentistry, New Orleans, LA, USA

**De Q.H. Tran, MD, FRCPC** Department of Anesthesiology, Montreal General Hospital, Montreal, QC, Canada

**Lien Tran, MD, FRCPC** Department of Anesthesiology, Louisiana State University Health Sciences Center, New Orleans, LA, USA

**Thomas Ngo Trang, MD** Department of Anesthesiology, Tulane University School of Medicine, New Orleans, LA, USA

**Richard D. Urman, MD, MBA, FASA** Department of Anesthesiology, Perioperative and Pain Medicine, Brigham and Women's Hospital, Boston, MA, USA

**Anna Uskova, MD** Department of Anesthesiology, University of Pittsburgh Medical Center, Pittsburgh, PA, USA

**Nalini Vadivelu, MBBS, MD, DNB** Department of Anesthesiology, Yale University, New Haven, CT, USA

**Francesco Vetri, MD, PhD** Department of Anesthesia, University of Illinois at Chicago, Chicago, IL, USA

**Lindsey Vokach-Brodsky, MBChB, FFARCSI** Department of Anesthesiology, Perioperative and Pain Medicine, Stanford University, Stanford, CA, USA

**Effrossyni G. Votta-Velis, MD, PhD** Clinical Anesthesiology, Department of Anesthesiology, University of Illinois at Chicago, Chicago, IL, USA

**Sylvia H. Wilson, MD** Department of Anesthesia and Perioperative Medicine, Medical University of South Carolina, Charleston, SC, USA

**Hong Yan, MD** Department of Anesthesiology, Wuhan Central Hospital, Wuhan, Hubei, China

**Si Zhang, DO** Department of Anesthesiology, Tulane University Hospital and Clinics, New Orleans, LA, USA