



# ANESTHESIOLOGY

The Journal of the American Society of Anesthesiologists, Inc. • [anesthesiology.org](http://anesthesiology.org)

Mission: Promoting scientific discovery and knowledge in perioperative, critical care, and pain medicine to advance patient care.

## EDITOR-IN-CHIEF

James C. Eisenach, M.D.  
Editor-in-Chief, ANESTHESIOLOGY  
Department of Anesthesiology  
Wake Forest University School of Medicine  
Medical Center Boulevard  
Winston-Salem, NC 27157  
Tel: (319) 356-4601  
1-800-260-5631  
E-mail: [editorial-office@anesthesiology.org](mailto:editorial-office@anesthesiology.org)

## PAST EDITORS-IN-CHIEF, ANESTHESIOLOGY

Henry S. Ruth, M.D., 1940–1955  
Ralph M. Tovell, M.D., 1956–1958  
James E. Eckenhoff, M.D., 1959–1962  
Leroy D. Vandam, M.D., 1963–1970  
Arthur S. Keats, M.D., 1971–1973  
Nicholas M. Greene, M.D., 1974–1976  
C. Philip Larson, Jr., M.D., 1977–1979  
John D. Michenfelder, M.D., 1980–1985  
Lawrence J. Saidman, M.D., 1986–1996  
Michael M. Todd, M.D., 1997–2006

## COVER ART

James P. Rathmell, M.D.  
Boston, Massachusetts  
Annemarie B. Johnson, C.M.I.  
Medical Illustrator  
Winston-Salem, North Carolina

## CME EDITORS

Leslie C. Jameson, M.D.  
Dan J. Kopacz, M.D.

## EDITORIAL OFFICE

George H. Kendall (Winston-Salem), Managing Editor  
E-mail: [managing-editor@anesthesiology.org](mailto:managing-editor@anesthesiology.org)  
Vicky J. Farrington-Howrey (Iowa City)  
Angel R. Marsh (Iowa City)  
Shawn A. Platt (Iowa City)  
Janan R. Winn (Iowa City)  
ANESTHESIOLOGY Journal  
Department of Anesthesia, 6546 JCP  
The University of Iowa  
200 Hawkins Drive  
Iowa City, IA 52242-1009  
Tel: (319) 356-4601; Fax (847) 720-9669  
E-mail: [editorial-office@anesthesiology.org](mailto:editorial-office@anesthesiology.org)

## LWW PUBLICATION STAFF

Druanne Martin, Publisher  
Joseph Albrecht, Journal Production Editor  
Debbie Moody, Journal Production Associate  
Michelle Smith, Senior Account Manager, Advertising  
Keida Spurlock, Classified Advertising Representative  
Silvia Serra, Director, Rights, Licensing & Permissions

## ASA OFFICERS

Jane C. K. Fitch, M.D., President  
John P. Abenstein, M.D., President-Elect  
John M. Zerwas, M.D., Immediate Past President  
Daniel J. Cole, M.D., First Vice-President  
Beverly K. Philip, M.D., Vice-President for Scientific Affairs

All articles accepted for publication are done so with the understanding that they are contributed exclusively to this Journal and become the property of the American Society of Anesthesiologists, Inc. Statements or opinions expressed in the Journal reflect the views of the author(s) and do not represent official policy of the American Society of Anesthesiologists unless so stated.



# ANESTHESIOLOGY

The Journal of the American Society of Anesthesiologists, Inc. • [anesthesiology.org](http://anesthesiology.org)

Mission: Promoting scientific discovery and knowledge in perioperative, critical care, and pain medicine to advance patient care.

## EDITOR-IN-CHIEF

James C. Eisenach, M.D.  
Winston-Salem, North Carolina

## EXECUTIVE EDITORS

Michael J. Avram, Ph.D., Chicago, Illinois  
Charles D. Collard, M.D., Houston, Texas  
Jerrold H. Levy, M.D., F.A.H.A., F.C.C.M.,  
Durham, North Carolina  
James P. Rathmell, M.D., Boston, Massachusetts  
David S. Warner, M.D., Durham, North Carolina

## STATISTICAL EDITOR

Timothy T. Houle, Ph.D.  
Winston-Salem, North Carolina

## EDITORS

J. David Clark, M.D., Ph.D., Palo Alto, California  
Shiroh Isono, M.D., Chiba, Japan  
Jean Mantz, M.D., Ph.D., Clichy, France  
Piyush M. Patel, M.D., F.R.C.P.C., San Diego, California  
David M. Roth, M.D., Ph.D., San Diego, California  
Daniel I. Sessler, M.D., Cleveland, Ohio  
Jeanine P. Wiener-Kronish, M.D., Boston, Massachusetts

## ASSOCIATE EDITORS

Julien Amour, M.D., Ph.D., Paris, France  
Takashi Asai, M.D., Ph.D., Osaka, Japan  
Brian Thomas Bateman, M.D., Boston, Massachusetts  
George S. Bause, M.D., M.P.H., Cleveland, Ohio  
Beatrice Beck-Schimmer, M.D., Zurich, Switzerland  
Chad Michael Brummett, M.D., Ann Arbor, Michigan  
John Butterworth, M.D., Richmond, Virginia  
Jaume Canet, M.D., Ph.D., Barcelona, Spain  
Carol Wiley Cassella, M.D., Seattle, Washington  
Deborah J. Culley, M.D., Boston, Massachusetts  
Albert Dahan, M.D., Ph.D., Leiden, The Netherlands  
Andrew J. Davidson, M.D., M.B.B.S., F.A.N.Z.C.A.,  
Melbourne, Australia  
Stefan G. De Hert, M.D., Ph.D., Ghent, Belgium  
Matthias Eikermann, M.D., Ph.D., Boston, Massachusetts  
Holger K. Eltzschig, M.D., Ph.D., Aurora, Colorado  
Pamela Flood, M.D., San Francisco, California  
Amanda A. Fox, M.D., M.P.H., Boston, Massachusetts  
Admir Hadzic, M.D., Ph.D., New York, New York  
Quinn H. Hogan, M.D., Milwaukee, Wisconsin  
Ru-Rong Ji, Ph.D., Durham, North Carolina  
Yandong Jiang, M.D., Ph.D., Boston, Massachusetts  
Franz Kehl, M.D., Ph.D., D.E.A.A., Karlsruhe, Germany  
Sachin Kheterpal, M.D., M.B.A., Ann Arbor, Michigan  
Yannick Le Manach, M.D., Ph.D., Hamilton, Canada  
Ronald S. Litman, D.O., F.A.A.P., Philadelphia, Pennsylvania  
Martin J. London, M.D., San Francisco, California  
Edward Mascha, Ph.D., Cleveland, Ohio  
George A. Mashour, M.D., Ph.D., Ann Arbor, Michigan  
Peter Nagele, M.D., M.Sc., St. Louis, Missouri  
Mark D. Neuman, M.D., M.Sc., Philadelphia, Pennsylvania  
Paolo Pelosi, M.D., Ph.D., Varese, Italy  
Jean-Francois Pittet, M.D., Birmingham, Alabama  
Warren S. Sandberg, M.D., Ph.D., Nashville, Tennessee  
Alan Jay Schwartz, M.D., M.S.Ed., Philadelphia, Pennsylvania  
Jamie W. Sleight, M.D., Hamilton, New Zealand  
Balachundhar Subramaniam, M.B.B.S., M.D., M.P.H.,  
Boston, Massachusetts

Access to articles published in ANESTHESIOLOGY is available to nonsubscribers through pay-per-view at the journal Web site, [www.anesthesiology.org](http://www.anesthesiology.org). Authors may order quantity print or electronic reprints of their own articles using the order form supplied with their proofs and posted to the journal Web site. For all other bulk purchases, please contact [reprintsolutions@wolterskluwer.com](mailto:reprintsolutions@wolterskluwer.com) in North America, Carlos Moreyra ([Carlos.Moreyra@wkglobal.com](mailto:Carlos.Moreyra@wkglobal.com)) in Latin America, and Jean Jones ([PS-Reprints@wolterskluwer.com](mailto:PS-Reprints@wolterskluwer.com)) in Europe and elsewhere.

ANESTHESIOLOGY is abstracted or indexed in Index Medicus/MEDLINE, Science Citation Index/SciSearch, Current Contents/Clinical Medicine, Current Contents/Life Sciences, Reference Update, EMBASE/Excerpta Medica, Biological Abstracts (BIOSIS), Chemical Abstracts, Hospital Literature Index, and Comprehensive Index to Nursing and Allied Health Literature (CINAHL).

The affiliations, areas of expertise, and conflict-of-interest disclosure statements for each Editor and Associate Editor can be found on the Journal's Web site ([www.anesthesiology.org](http://www.anesthesiology.org)).