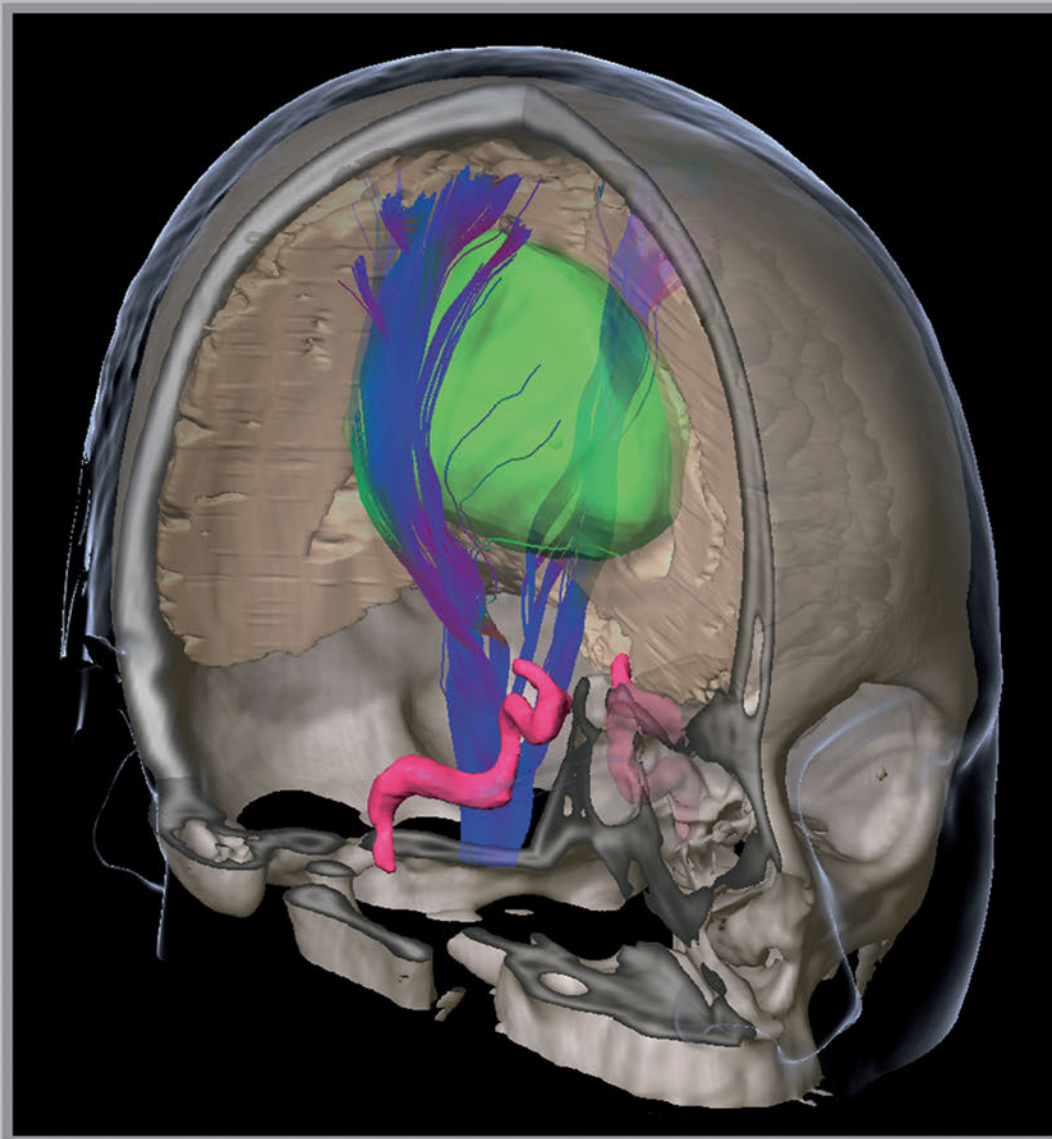


Controversies in Neuro-Oncology

Best Evidence Medicine for Brain Tumor Surgery

Alfredo Quiñones-Hinojosa

Shaan M. Raza



Controversies in Neuro-Oncology

Best Evidence Medicine for Brain Tumor Surgery

Controversies in Neuro-Oncology

Best Evidence Medicine for Brain Tumor Surgery

Alfredo Quiñones-Hinojosa, MD, FAANS, FACS

Professor of Neurological Surgery and Oncology
Neuroscience and Cellular and Molecular Medicine
Director, Brain Tumor Surgery Program
Johns Hopkins–Bayview
Director, Pituitary Surgery Program
The Johns Hopkins Hospital
Baltimore, Maryland

Shaan M. Raza, MD

Department of Neurosurgery
The Johns Hopkins Hospital
Baltimore, Maryland

Thieme Medical Publishers, Inc.
333 Seventh Ave.
New York, NY 10001

Executive Editor: Kay Conerly
Managing Editor: Judith Tomat
Editorial Assistant: Genevieve Kim
Senior Vice President, Editorial and Electronic Product Development: Cornelia Schulze
Production Editor: Kenneth L. Chumbley
International Production Director: Andreas Schabert
Vice President, Finance and Accounts: Sarah Vanderbilt
President: Brian D. Scanlan
Compositor: Prairie Papers Inc.
Printer: Everbest Printing Co. Ltd.

Library of Congress Cataloging-in-Publication Data

Controversies in neuro-oncology : best-evidence medicine for brain tumor surgery / [edited by] Alfredo Quiñones-Hinojosa, Shaan M. Raza.

p. ; cm.

Includes bibliographical references and index.

ISBN 978-1-60406-755-2—ISBN 978-1-60406-756-9 (eISBN)

I. Quiñones-Hinojosa, Alfredo. II. Raza, Shaan M.

[DNLM: 1. Brain Neoplasms—surgery. 2. Brain Neoplasms—radiotherapy. 3. Evidence-Based Medicine—methods. 4. Neurosurgical Procedures. 5. Radiosurgery—methods. WL 358]

RC280.B7

616.99'481—dc23

2013013422

Copyright © 2014 by Thieme Medical Publishers, Inc. This book, including all parts thereof, is legally protected by copyright. Any use, exploitation, or commercialization outside the narrow limits set by copyright legislation without the publisher's consent is illegal and liable to prosecution. This applies in particular to photostat reproduction, copying, mimeographing or duplication of any kind, translating, preparation of microfilms, and electronic data processing and storage.

Important note: Medical knowledge is ever-changing. As new research and clinical experience broaden our knowledge, changes in treatment and drug therapy may be required. The authors and editors of the material herein have consulted sources believed to be reliable in their efforts to provide information that is complete and in accord with the standards accepted at the time of publication. However, in view of the possibility of human error by the authors, editors, or publisher of the work herein or changes in medical knowledge, neither the authors, editors, nor publisher, nor any other party who has been involved in the preparation of this work, warrants that the information contained herein is in every respect accurate or complete, and they are not responsible for any errors or omissions or for the results obtained from use of such information. Readers are encouraged to confirm the information contained herein with other sources. For example, readers are advised to check the product information sheet included in the package of each drug they plan to administer to be certain that the information contained in this publication is accurate and that changes have not been made in the recommended dose or in the contraindications for administration. This recommendation is of particular importance in connection with new or infrequently used drugs.

Some of the product names, patents, and registered designs referred to in this book are in fact registered trademarks or proprietary names even though specific reference to this fact is not always made in the text. Therefore, the appearance of a name without designation as proprietary is not to be construed as a representation by the publisher that it is in the public domain.

Printed in China

5 4 3 2 1

ISBN 978-1-60406-755-2

Also available as an e-book:
eISBN 978-1-60406-756-9

To our families for their love, devotion, inspiration, and endless support in our academic and clinical pursuits.

To our mentors for their patient guidance and mentorship and for instilling in us the importance and excitement of seeking answers and new knowledge.

Contents

Foreword	xi
Preface	xiii
Acknowledgments	xv
Contributors	xvii
1 Introduction to Best Evidence Medicine <i>Alexander R. Vaccaro and Jason C. Eck</i>	1
Section I Astrocytomas	
2 The Role of Gross Total Resection in Low-Grade Gliomas <i>Marco Riva and Lorenzo Bello</i>	9
3 The Role of Surgery in the Management of High-Grade Gliomas (Newly Diagnosed, Recurrent, and Multifocal High-Grade Gliomas) <i>Brian Yu-Jin Hwang, Kaisorn L. Chaichana, and Alfredo Quiñones-Hinojosa</i>	18
4 Adjuvants in the Surgical Resection of Astrocytomas (Intraoperative MRI and 5-ALA) <i>Kimon Bekelis and David W. Roberts</i>	25
5 The Role of Intraoperative Mapping in the Resection of Low-Grade Gliomas <i>Hugues Duffau</i>	31
6 The Role of Awake Craniotomy in the Resection of Astrocytomas <i>Nader Sanai, Douglas A. Hardesty, and Mitchel S. Berger</i>	48
7 The Role of Surgery versus Biopsy in the Management of Gliomas in the Elderly (Patients over 65) <i>Nader Sanai and Douglas A. Hardesty</i>	55
8 The Role of Surgery in Brainstem Gliomas (Pediatric and Adult) <i>Mari L. Groves, Pablo F. Recinos, and George Jallo</i>	61
9 The Role of Local Drug Delivery in Management of Newly Diagnosed and Recurrent High-Grade Gliomas <i>Mahua Dey, Henry Brem, and Maciej S. Lesniak</i>	76

10	The Role of Adjuvant Therapy in Newly Diagnosed High-Grade Astrocytomas <i>Isabel Arrillaga-Romany, Manmeet S. Ahluwalia, and Patrick Y. Wen</i>	91
11	Salvage Therapy for High-Grade Gliomas <i>David S. Wolf and John Laterra</i>	97
Section II Pineal Region Tumors		
12	Intracranial Germ Cell Tumors—Treatment Paradigms <i>Soriaya Motivala, Mustafa Nadi, and James T. Rutka</i>	107
13	Surgery versus Initial Trial of Radiation in the Management of Pineal Region Tumors <i>Ramiro Del Valle, Javier Avendaño, and Juan Barges Coll</i>	114
14	The Role of Gross Total Resection in the Management of Pineal Region Tumors <i>Hani R. Malone, Victoria Ebiana, and Jeffrey N. Bruce</i>	122
Section III Intraventricular Tumors		
15	The Role of Adjuvant Therapy in Subtotal Resection and High-Grade Ependymomas <i>Carmen Kut and Kristin Janson Redmond</i>	139
16	The Role of Surgery in the Management of Asymptomatic Colloid Cysts without Hydrocephalus <i>David A. Wilson and Peter Nakaji</i>	145
17	Evidence-Based Management of Central Neurocytoma (Gross Total Resection versus Subtotal Resection and the Role of Adjunctive Therapies) <i>J. Dawn Waters, David Gonda, Clark C. Chen, and Bob S. Carter</i>	155
18	The Role of Surgery in Intraventricular High-Grade Astrocytomas <i>Edjah K. Nduom and Costas G. Hadjipanayis</i>	162
Section IV Hemangioblastomas		
19	The Role of Surgery in von Hippel-Lindau Disease with Craniospinal Hemangioblastomas <i>David B. Weintraub and Russell R. Lonser</i>	173
20	The Role of Radiosurgery in the Management of Hemangioblastomas <i>Sze Chun Ho and Ashok R. Asthagiri</i>	180
Section V Medulloblastoma		
21	The Role of Surgery in the Treatment of Children with Medulloblastoma <i>M. Özgür Taşkapilioglu and James T. Rutka</i>	189
22	The Role of Adjuvant Therapy in Medulloblastoma with and without Neuroaxis Seeding <i>Erin M. Dunbar</i>	197
Section VI Metastases		
23	Surgery, Radiosurgery, or Whole Brain Radiotherapy for One to Three Asymptomatic Intracranial Metastases <i>Ganesh M. Shankar and Daniel P. Cahill III</i>	219

24	Surgery Followed by Radiosurgery Boost for Metastases <i>Christopher Jackson, James K. C. Liu, Pablo F. Recinos, and Michael Lim</i>	225
25	The Role of Surgery in Patients Presenting with Multiple Metastases <i>J. Bradley Elder and E. Antonio Chiocca</i>	233
26	Stereotactic Radiosurgery (SRS) versus Whole-Brain Radiation Therapy (WBRT) in the Management of Multiple Brain Metastases <i>Usama Mahmood, Zain A. Husain, Young Kwok, and William F. Regine</i>	244
27	Evidence-Based Management of Leptomeningeal Metastasis from Solid Tumors <i>Jennie W. Taylor and Andrew Norden</i>	252

Section VII Extra-Axial Tumors and Skull Base Tumors

28	The Role of Radiosurgery in Newly Diagnosed Meningiomas <i>Douglas Kondziolka, Neal Luther, Hideyuki Kano, Ajay Niranjana, John C. Flickinger, and L. Dade Lunsford</i>	263
29	The Role of Preoperative Embolization for Meningiomas (Skull Base and Non-Skull Base) <i>Alex M. Witek, Geoffrey P. Colby, Li-Mei Lin, and Alexander L. Coon</i>	271
30	Adjuvant Therapies (Chemotherapy and Radiation Therapy) for Atypical and Anaplastic Meningiomas <i>Manmeet S. Ahluwalia, Rohan Garje, Patrick Y. Wen, and Minesh Mehta</i>	283
31	Extent of Resection and Selection of Operative Approaches in the Surgical Management of Petroclival Meningiomas <i>David S. Xu, Nader Sanai, and Robert F. Spetzler</i>	291
32	Need for Gross Total Resection of Cranial Base Meningiomas <i>Gustavo Pradilla and Jacques Morcos</i>	298

Section VIII Hemangiopericytomas

33	Is There a Need for Gross Total Resection in Management of Hemangiopericytomas in the Era of Radiosurgery? <i>Syed M. A. Karim, Anand Veeravagu, and Steven D. Chang</i>	317
----	--	-----

Section IX Meningeal Sarcoma

34	The Role of Surgery and Adjuvant Therapies for Meningeal Sarcoma with Brain Invasion <i>Edward W. Swanson and Chad R. Gordon</i>	325
----	--	-----

Section X Pituitary Tumors

35	The Role of Surgery in Nonfunctioning Pituitary Macroadenomas <i>Kaisorn L. Chaichana, Brian Yu-Jin Hwang, Shaan M. Raza, and Alfredo Quiñones-Hinojosa</i>	337
36	The Role of Inferior Petrosal Sinus Sampling for Cushing Disease with Modern Dynamic Magnetic Resonance Imaging <i>Roukoz Chamoun and William T. Couldwell</i>	349
37	The Role of Surgery for Recurrent Cushing's Disease <i>Garni Barkhoudarian and Edward R. Laws Jr.</i>	356

38	Management of Pituitary Apoplexy (Early versus Delayed Surgery) <i>Michael Schiraldi and Chirag G. Patil</i>	362
39	Stereotactic Radiosurgery for Functioning and Nonfunctioning Pituitary Adenomas <i>Jason Sheehan and Zhiyuan Xu</i>	368
Section XI Craniopharyngiomas		
40	Controversies in the Surgical Treatment of Craniopharyngiomas <i>Tong Yang and Theodore H. Schwartz</i>	381
41	Use of Radiotherapy in Optimizing Management of Craniopharyngioma <i>Lawrence Kleinberg</i>	391
42	Intra-Cyst Therapies for Craniopharyngiomas <i>Graeme F. Woodworth and Jon D. Weingart</i>	401
Section XII Cranial Base Malignancies		
43	Open versus Endoscopic Resection of Midline Anterior Cranial Base Malignancy <i>D. David Beahm, Tyler J. Kenning, Christopher J. Farrell, Marc R. Rosen, and James J. Evans</i>	409
44	The Role of Craniofacial Resection in Anterior Skull Base Malignancies <i>Shaan M. Raza and Franco DeMonte</i>	422
Section XIII Chordomas		
45	The Role of Surgery in the Management of Skull Base Chordomas <i>Jacob Ruzevick, Shaan M. Raza, and Alfredo Quiñones-Hinojosa</i>	433
46	Radiosurgery and Fractionated Radiotherapy Techniques for Chordomas <i>Hideyuki Kano, Douglas Kondziolka, and L. Dade Lunsford</i>	442
Section XIV Vestibular Schwannomas		
47	Radiosurgery versus Surgery versus Observation in the Initial Management of Vestibular Schwannomas <i>Pablo F. Recinos, Bjorn Lobo, Eric Sankey, and Daniele Rigamonti</i>	451
48	Goals of Surgery in the Management of Vestibular Schwannomas <i>Anand V. Germanwala, Howard Francis, and Rafael J. Tamargo</i>	461
Section XV Glomus Jugulare Tumors		
49	Surgery versus Radiosurgery for Glomus Jugulare Tumors <i>Osamah J. Choudhry, Smruti K. Patel, and James K. Liu</i>	469
	Index	471

Foreword

I am honored by my assignment to pen a Foreword to this unprecedented achievement by Drs. Quinones and Raza.

In their Preface, Quinones and Raza acknowledge the past, but the emphasis throughout is to address major surgical controversies in conjunction with each expert's recommendations and the critical supporting evidence. The authorship of each section is a literal "who's who" in the field.

Looking ahead, the authors emphasize the need for prospective clinical studies to generate higher levels of evidence to support our practice.

I envy the editors—who are also contributors—for a book that I had one day hoped to write. I came into the field before it acquired a name. I and others subscribed to the belief that there are no "benign" brain tumors. The distinction between benign and malignant was more time-related than biology-related. In effect, the difference had the same end-point (death), preceded by disability. Exceptions were rare, such as densely-calcified meningiomas, whose victims outlived the tumor. In the past, the life-cycle of these tumors reached a steady state in which cell-death met

or exceeded the rate of mitotic cell birth. One such example is the time-scale of irradiated meningiomas.

In closing, I expose my insecurity as the sole author of a Foreword to an achievement so grand and comprehensive.

All neurosurgeons, medical and surgical generalists, and subspecialists need to have this volume in their library as they sit in front of each patient to provide an unbiased and evidence-based recommendation.

As neurosurgeons, we are pledged to give every patient the best-known advice: "doing unto others what you want done to you," devoid of personal prejudice and contrary personal experience.

Sincerely and with gratitude to the authors,

Charles B. Wilson, MD, DSc, MSHA
Professor Emeritus
Department of Neurological Surgery
University of California—San Francisco
San Francisco, California

Preface

In these days when science is clearly in the saddle and when our knowledge of disease is advancing at a breathless pace, we are apt to forget that not all can ride and that he also serves who waits and who applies what the horseman discovers.

Harvey Cushing

The field of neurosurgery is considered by some as relatively young, but in the last several decades its practice has undergone a tremendous metamorphosis. Within the specialty, neurooncology has perhaps experienced the greatest degree of expansion. With our improved anatomic understanding in parallel with technological advances, we've seen the innovation of new surgical techniques (e.g., endoscopy for skull base tumors) along with the adoption of new technologies into the operating room (e.g., intraoperative MRI, 5-aminolevulinic acid). Concurrently, our recognition of the fact that modern medical care demands multidisciplinary collaboration has placed the neurosurgical management of brain tumors in harmony with other surgical and nonsurgical specialists. This collaboration has also fostered innovation with the introduction of varying treatment options (e.g., radiosurgery) and protocols that are now part of our armamentarium. Furthermore, as any clinician who participates in the care of cancer patients recognizes, our search for a cure via research has also spurred the development of new biologic therapies, which we must now try to understand and incorporate if possible into our decision making while caring for patients.

As we sit in front of patients and attempt to present our best clinical recommendation, more often than we like, we still rely primarily on our experience and a limited understanding of the published evidence, which can often be based on flawed studies. These practical clinical issues are now magnified with the recent health care reform. With the

need to improve spending and access to health care, physicians are now increasingly being asked to justify interventions and to provide better care at a more affordable cost. With the introduction of organizations such as Accountable Care Organizations, institutional practices are now linking provider reimbursements to quality metrics, while being liable for the appropriateness and efficiency of the health care provided. Consequently, any intervention must be justified by data. Hence, it is imperative that we not only have a mastery of the evidence but also have good quality evidence to guide and defend our clinical decision making, while providing the best care possible.

In light of these obstacles, we set out to create an up-to-date review by different world-experts that would address some of the major surgical controversies in the field of neurooncology in the context of evidence-based medicine. We asked the major leaders in the field to not only summarize and critique currently available evidence but also to provide their expert opinion regarding their assigned topic. The book will cover the major tumor types and their associated controversies. Each chapter will provide not only the relevant background but also discuss all the relevant literature on the subject. At the end of each chapter, you will find a table summarizing each expert's recommendations and their level of supporting evidence. In this process we intend not only to provide you with a guide to navigate some of the major decisions encountered while talking to patients with brain tumors, but also to understand the supporting evidence. This body of work is not intended to be final but a starting point from which one can further build evidence to support our management of patients that is based on best-evidence-medicine.

We hope that as you read this text you will appreciate the great amount of research that has been

done thus far in the field by so many dedicated experts. Nonetheless, this volume should also highlight the need for prospective clinical studies to generate higher levels of evidence to support our practice. While the art of medicine lies in a practitioner's experience and clinical acumen, objective data is still necessary as a foundation. Hence, neurosurgeons need to remain intensely involved with basic, translational, and clinical research to help improve and in-

novate the care of patients, especially in the context of surrounding social and government changes. As you will see, major challenges and knowledge gaps still remain to which we hope future research will provide answers.

Alfredo Quiñones-Hinojosa
Shaan M. Raza

Acknowledgments

In the fall of 2010, we conceived an idea for a book that would highlight the current state of affairs, controversies, and underlying evidence around the management of brain tumors. Initially, due to the rapid evolution in science and medicine, we were apprehensive about whether or not such a book would be worthwhile; however, our concerns vanished as we discussed the concept with friends and colleagues around the world.

Assembling the material for this book has given us time to reflect on the things that matter most to us and the people who have shaped our training and current practices. We are humbled by the mentors and colleagues with whom we have had the privilege of working, and the new relationships we continue to form. We are extremely grateful to our mentors and colleagues who contributed to this project, all of whom are well published and innovative thinkers. We appreciate them taking the time to write thoughtful text addressing some of the more controversial topics in our field. Their reviews and expert insights into the evidence behind our practices have helped to make this book a unique addition to the neurosurgical library.

We are extraordinarily thankful for the support and encouragement that we have received from our Chairman, Dr. Henry Brem, and our Director of Neuro-oncology, Dr. Alessandro Olivi, as we initiated this project and throughout the entire process. We are also grateful to our colleagues in the Departments of Neurosurgery and Oncology at Johns Hopkins, as well as many other medical students, residents, and fellows, who have continued to work together to help us with the material over many nights, weekends, and holidays to ensure we produced a book that would make us all proud.

Profound gratitude goes to the tremendous efforts of the editorial staff at Thieme Publishers: Kay Conerly (Executive Editor), Judith Tomat (Managing Editor), Genevieve Kim (Editorial Assistant), and Kenny Chumbley (Production Editor), in addition to Colleen Hickson (Administrative Assistant at Johns Hopkins), for their patient support and commitment to excellence. Their tireless efforts made the process of putting together this project truly an enjoyable experience. Well-deserved thanks go out to our Physician Assistant, Jill Anderson, and Medical Office Coordinator, Tasha Leak, for their patience and continued care for our patients battling brain tumors.

Contributors

Manmeet S. Ahluwalia, MD, FACP

Section Head, Neuro-Oncology Outcomes
The Rose Ella Burkhardt Brain Tumor and
Neuro-Oncology Center, Neurological Institute
Cleveland Clinic
Cleveland, Ohio

Isabel Arrillaga-Romany, MD, PhD

Center for Neuro-Oncology
Dana-Farber Cancer Institute
Brigham and Women's Cancer Center
Boston, Massachusetts

Ashok R. Asthagiri, MD

Assistant Clinical Investigator
Surgical Neurology Branch
National Institute of Health
Bethesda, Maryland

Javier Avendaño, MD

Neurosurgeon
Department of Neurosurgery
Médica Sur Hospital
Mexico City, Mexico

Garni Barkhoudarian, MD

Faculty Neurosurgeon
Brain Tumor Center and Pituitary Disorders Program
John Wayne Cancer Institute at St. John's Health Center
Santa Monica, California

D. David Beahm, MD

Assistant Professor
University of Kansas Medical Center
Department of Otolaryngology
Kansas City, Kansas

Kimon Bekelis, MD

Section of Neurosurgery
Dartmouth-Hitchcock Medical Center
Lebanon, New Hampshire

Lorenzo Bello, MD

Associate Professor of Neurosurgery
Università degli Studi di Milano
Director of Neurosurgical Oncology
Istituto Clinico Humanitas, IRCCS
Milano, Italy

Mitchel S. Berger, MD, FACS, FAANS

Kathleen M. Plant Distinguished Professor
Chairman, Department of Neurological Surgery
Director, Brain Tumor Research Center
University of California–San Francisco
San Francisco, California

Henry Brem, MD

Professor of Neurological Surgery and Oncology
Director, Department of Neurosurgery
Harvey Cushing Professor of Neurosurgery
Neurosurgeon-in-Chief
The Johns Hopkins Hospital
Director, Hunterian Neurosurgical Research
Laboratory
Baltimore, Maryland

Jeffrey N. Bruce, MD

Edgar M. Housepian Professor of Neurological
Surgery
Department of Neurological Surgery
Columbia University
New York, New York

Daniel P. Cahill III, MD, PhD

Laboratory Director
Department of Neurosurgery
Massachusetts General Hospital
Boston, Massachusetts

Bob S. Carter, MD, PhD

Professor and Chief of Neurosurgery
University of California–San Diego
La Jolla, California

Kaisorn L. Chaichana, MD

Department of Neurosurgery
Johns Hopkins University School of Medicine
Baltimore, Maryland

Roukoz Chamoun, MD

Department of Neurosurgery
University of Kansas Hospital
Kansas City, Kansas

Steven D. Chang, MD

Robert C. and Jeannette Powell Professor of
Neurosurgery
Department of Neurosurgery
Stanford University School of Medicine
Stanford, California

Clark C. Chen, MD, PhD

Chief, Stereotactic and Neurosurgery
Department of Neurosurgery
University of California–San Diego
La Jolla, California

E. Antonio Chiocca, MD, PhD, FAANS

Professor of Surgery
Harvard Medical School
Neurosurgeon-in-Chief and Chairman
Department of Neurosurgery
Co-Director, Institute for the Neurosciences at the
Brigham and Women's Faulkner Hospital
Surgical Director, Center for Neuro-Oncology
Dana-Farber Cancer Institute
Boston, Massachusetts

Osamah J. Choudhry, MD

Department of Neurosurgery
New York University Medical Center
New York, New York

Geoffrey P. Colby, MD, PhD

Department of Neurosurgery
Johns Hopkins University School of Medicine
Baltimore, Maryland

Juan Barges Coll, MD, MSc

Assistant Professor
Skull Base Surgery
Instituto Nacional de Neurología y Neurocirugía
Hospital Medica Sur Neurosurgical Department
Mexico City, Mexico

Alexander L. Coon, MD

Assistant Professor of Neurosurgery, Neurology, and
Radiology
Director of Endovascular Neurosurgery
The Johns Hopkins Hospital
Baltimore, Maryland

William T. Couldwell, MD, PhD

Professor and Chairman
Department of Neurosurgery
University of Utah
Salt Lake City, Utah

Ramiro Del Valle, MD

Director
Gamma Knife Unit
Médica Sur Hospital
Mexico City, Mexico

Franco DeMonte, MD, FRCS, FACS

Professor of Neurosurgery and Head and Neck
Surgery
Mary Beth Pawelek Chair in Neurosurgery
Department of Neurosurgery
The University of Texas M. D. Anderson Cancer Center
Houston, Texas

Mahua Dey, MD

Department of Surgery, Neurosurgery
University of Chicago
Chicago, Illinois

Hugues Duffau, MD, PhD

Professor and Chairman
Department of Neurosurgery and INSERM 1051
Montpellier University Medical Center
Montpellier, France

Erin M. Dunbar, MD

Assistant Professor
Department of Neurosurgery
University of Florida
Gainesville, Florida

Victoria Ebiana, MD

Department of Neurological Surgery
The Neurological Institute
Columbia University
New York, New York