

The Evidence for Neurosurgery

Edited by Zoher Ghogawala
Ajit A. Krishnaney
Michael P. Steinmetz
H. Hunt Batjer
Edward C. Benzel

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Tel: +44 (0)1952 510061
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Cover image of cerebrovascular bypass – courtesy of Dr. Carlos David (Lahey Clinic Medical Center)

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Tel: +356 21897037; Fax: +356 21800069.

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Contributors

Kalil G Abdullah BS Medical Student, Cleveland Clinic Lerner College of Medicine, Cleveland, Ohio, USA

Isaac Josh Abecassis BSc Medical Student, Department of Neurological Surgery, Northwestern University Feinberg School of Medicine and McGaw Medical Center, Chicago, Illinois, USA

Samuel Adediran BS Medical Student, Wright State University Medical School, Dayton, Ohio, USA

Manish K Aghi MD PhD Assistant Professor, Department of Neurological Surgery, University of California, San Francisco, California, USA

Lilyana Angelov MD Head Section of Spine Tumors and Staff Neurosurgeon, Center for Spine Health; Brain Tumor and NeuroOncology Center, Cleveland Clinic, Cleveland, Ohio, USA

Salah G Aoun MD Postdoctoral Research Fellow, Department of Neurological Surgery, Northwestern University Feinberg School of Medicine and McGaw Medical Center, Chicago, Illinois, USA

Fred G Barker II MD Associate Professor of Neurosurgery, Harvard Medical School, Massachusetts General Hospital, Boston, Massachusetts, USA

H Hunt Batjer MD FACS FAANS Michael J Marchese Professor and Chair, Department of Neurological Surgery, Northwestern University Feinberg School of Medicine and McGaw Medical Center, Chicago, Illinois, USA

Jason Beiko MD PhD Assistant Professor, Section of Neurosurgery, University of Manitoba, Winnipeg, Canada

Bernard R Bendok MD FACS FAANS FAHA Associate Professor, Departments of Neurological Surgery and Radiology, Northwestern University Feinberg School of Medicine and McGaw Medical Center, Chicago, Illinois, USA

Edward C Benzel MD Chairman, Department of Neurosurgery; Staff, Center for Spine Health, Cleveland Clinic, Cleveland, Ohio, USA; Professor of Surgery, Cleveland Clinic Lerner College of Medicine at Case Western Reserve University (CCLCM of CWRU), Cleveland, Ohio, USA

Jeffrey P Blount MD Associate Professor, Section of Pediatric Neurosurgery, Children's of Alabama, University of Alabama at Birmingham, Birmingham, Alabama, USA

David W Cadotte MSc MD Neurosurgery Resident, Division of Neurosurgery, University of Toronto, Toronto, Ontario, Canada

Daniel P Cahill MD PhD Assistant Professor; Attending Neurosurgeon, Department of Neurosurgery, Massachusetts General Hospital, Harvard Medical School, Boston, Massachusetts, USA

Bob S Carter MD PhD Professor and Chief of Neurosurgery, University of California, San Diego, California, USA

Randall M Chesnut MD FCCM FACS Integra Endowed Professor of Neurotrauma; Chief of Neurotrauma and Neurosurgical Spine Surgery, Department of Neurological Surgery; Professor, Department of Orthopaedic Surgery; Adjunct Professor, School of Global Health, Harborview Medical Center, University of Washington, Seattle, Washington, USA

E Sander Connolly MD Bennett M Stein Professor of Neurological Surgery; Vice Chairman of Neurosurgery; Director, Cerebrovascular Research Laboratory, Department of Neurological Surgery, The Neurologic Institute of New York, Columbia University, New York, USA

Celina M Crisman MD Resident, Department of Neurological Surgery, University of Medicine and Dentistry of New Jersey, Newark, New Jersey, USA

Colin P Derdeyn MD Professor of Radiology, Neurology and Neurological Surgery; Director, Stroke and Cerebrovascular Center, Washington University, St Louis, Missouri, USA

Andrea F Douglas MD Director of Spine Education and Research, Wallace Clinical Trials Center, Greenwich Hospital, Greenwich, Connecticut, USA; Clinical Assistant Professor of Neurosurgery, NYU Langone Medical Center, New York, USA

James M Drake MBBCh MSc FRCSC Professor and Neurosurgeon-in-Chief, Division of Neurosurgery, Hospital for Sick Children, University of Toronto, Toronto, Ontario, Canada

Andrew F Ducruet MD Chief Resident, Department of Neurological Surgery, The Neurologic Institute of New York, Columbia University, New York, USA

Emad N Eskandar MD Associate Professor, Director of Stereotactic and Functional Neurosurgery, Department of Neurosurgery, Massachusetts General Hospital, Harvard Medical School, Boston, Massachusetts, USA

Hamad Farhat MD Clinical Assistant Professor, Department of Neurological Surgery, NorthShore University HealthSystem, Evanston, Illinois, USA

Michael G Fehlings MD PhD FRCSC FACS Professor of Neurosurgery, Division of Neurosurgery, University of Toronto, Toronto, Ontario, Canada

Andria L Ford MD Assistant Professor of Neurology, Department of Neurology, Washington University, St Louis, Missouri, USA

Julio C Furlan MD MBA MSc PhD Neurology Resident, Division of Neurosurgery, University of Toronto, Toronto, Ontario, Canada

George M Ghobrial MD Neurological Surgery Resident, Department of Neurological Surgery, Thomas Jefferson University Hospital, Philadelphia, Pennsylvania, USA

Zoher Ghogawala MD FACS Director, Wallace Clinical Trials Center, Greenwich, Connecticut, USA; Charles A Fager Chairman of Neurosurgery, Lahey Clinic Medical Center, Burlington, Massachusetts, USA; Associate Professor of Neurosurgery, Tufts University School of Medicine, Boston, Massachusetts, USA

Michael W Groff MD Director of Spinal Neurosurgery; Co-Director Spine Center, Department of Neurosurgery, Brigham and Women's Hospital, Harvard Medical School, Boston, Massachusetts, USA

Ryder Gwinn MD Director of Epilepsy and Functional Neurosurgery, Swedish Medical Center, Swedish Neuroscience Institute, Seattle, Washington, USA

Todd C Hankinson MD MBA Assistant Professor of Neurosurgery, Children's Hospital Colorado, University of Colorado Denver, Aurora, Colorado, USA

Raqeeb Haque MD Chief Resident, Department of Neurological Surgery, The Neurologic Institute of New York, Columbia University, New York, USA

Ran Harel MD Faculty, Spine Surgery and Spine Radiosurgery, The Department of Neurosurgery and Spine Surgery, The Talpiot Medical Leadership Program, Sheba Medical Center, Israel

James Harrop MD FACS Associate Professor, Departments of Neurological and Orthopedic Surgery; Chief, Spine and Peripheral Nerve Surgery, Department of Neurological Surgery, Thomas Jefferson University Hospital, Philadelphia, Pennsylvania, USA

Brian L Hoh MD Associate Professor, University of Florida, Department of Neurological Surgery, Gainesville, Florida, USA

Brian Y Hwang MD Resident, Department of Neurological Surgery, The Johns Hopkins University, Baltimore, Maryland, USA

Steven N Kalkanis MD Co-Director, Hermelin Brain Tumor Center; Vice-Chair for Operations, Department of Neurosurgery, Henry Ford Health System, Detroit, Michigan, USA

Matthew Kimball MD Resident Physician, University of Florida, Department of Neurological Surgery, Gainesville, Florida, USA

Paul Klimo Jr MD MPH Neurosurgeon, Semmes-Murphey Neurologic & Spine Clinic, Memphis, Tennessee, USA; St Jude Children's Research Hospital, Memphis, Tennessee, USA

Ajit A Krishnaney MD Staff Neurosurgeon, Center for Spine Health, Cerebrovascular Center, Department of Neurosurgery, Cleveland Clinic, Cleveland, Ohio, USA

Abhaya V Kulkarni MD PhD FRCSC Associate Professor and Neurosurgeon, Division of Neurosurgery, Hospital for Sick Children, University of Toronto, Toronto, Ontario, Canada

Fred C Lam MD PhD FRCSC Fellow in Training, Department of Neurosurgery, Brigham and Women's Hospital, Harvard Medical School, Boston, Massachusetts, USA

Jin-Moo Lee MD PhD Associate Professor of Neurology, Radiology, and Biomedical Engineering; Director, Cerebrovascular Disease Section, Washington University, St Louis, Missouri, USA

Michael J Link MD Professor of Neurosurgery, Mayo Clinic College of Medicine, Rochester, Minnesota, USA

Geoffrey T Manley MD PhD Professor of Neurosurgery and Vice-Chairman, Department of Neurosurgery and the Brain and Spinal Injury Center (BASIC), University of California, San Francisco, California, USA

Matthew K Mian BSE Medical Student, Department of Neurosurgery, Massachusetts General Hospital, Harvard Medical School, Boston, Massachusetts, USA

Brian D Milligan MD Neurosurgical Resident, Mayo Clinic College of Medicine, Rochester, Minnesota, USA

Jacques J Morcos MD FRCS(Eng) FRCS(Ed) Professor of Clinical Neurosurgery and Otolaryngology, Department of Neurological Surgery, University of Miami, Miami, Florida, USA

Thomas E Mroz MD Director, Spine Surgery Fellowship, Cleveland Clinic, Cleveland, Ohio, USA

Praveen V Mummaneni MD Associate Professor and Vice Chairman, Department of Neurological Surgery, University of California, San Francisco, California, USA

Atsuhiko Nakagawa MD PhD Assistant Professor of Neurosurgery, Department of Neurosurgery and the Brain and Spinal Injury Center (BASIC), University of California, San Francisco, California, USA; Department of Neurosurgery, Tohoku University Hospital, Sendai, Japan

Michael C Oh MD PhD Resident Physician, Department of Neurological Surgery, University of California, San Francisco, California, USA

Alexander M Papanastassiou MD Assistant Professor of Neurosurgery, University of Texas Health Science Center, San Antonio, Texas, USA

Sanjay Patra MD Chief Resident, Neurosurgery, Department of Neurosurgery, Henry Ford Health System, Detroit, Michigan, USA

Bruce E Pollock MD Professor of Neurosurgery and Radiation Oncology, Mayo Clinic College of Medicine, Rochester, Minnesota, USA

Corey Raffel MD Neurosurgeon, Nationwide Children's Hospital, Columbus, Ohio, USA

Rudy J Rahme MD Postdoctoral Research Fellow, Department of Neurological Surgery, Northwestern University Feinberg School of Medicine and McGaw Medical Center, Chicago, Illinois, USA

Daniel K Resnick MD MS Professor and Vice Chairman, Department of Neurosurgery, University of Wisconsin, Madison, Wisconsin, USA

Rajiv Saigal MD PhD Neurotrauma Research Fellow, Department of Neurosurgery and the Brain and Spinal Injury Center (BASIC), University of California, San Francisco, California, USA

Nader Sanai MD Director, Neurosurgical Oncology, Division of Neurosurgical Oncology; Director, Barrow Brain Tumor Research Center, Barrow Neurological Institute, Phoenix, Arizona, USA

Richard Schlenk MD Neurosurgery Program Director, Cleveland Clinic Foundation, Cleveland, Ohio, USA

Stephen F Shafizadeh MD PhD Resident Physician, PGY-6 and Enfolded Cerebrovascular and Skull Base Fellow, Department of Neurological Surgery, Northwestern University Feinberg School of Medicine and McGaw Medical Center, Chicago, Illinois, USA

Sameer A Sheth MD PhD Chief Resident in Neurosurgery, Department of Neurosurgery, Massachusetts General Hospital, Harvard Medical School, Boston, Massachusetts, USA

Harminder Singh MD Clinical Assistant Professor of Neurological Surgery, Stanford Neurological Surgery, Stanford, California, USA

Edward R Smith MD Director, Pediatric Cerebrovascular Surgery, Department of Neurosurgery, Children's Hospital Boston, Massachusetts, USA; Associate Professor of Surgery, Harvard Medical School, Boston, Massachusetts, USA

Robert A Solomon MD Byron Stookey Professor of Neurosurgery; Chairman and Director of Service, Department of Neurological Surgery, The Neurologic Institute of New York, Columbia University, New York, USA

Dennis D Spencer MD Harvey and Kate Cushing Professor of Neurosurgery; Chairman, Department of Neurosurgery, Yale University, New Haven, Connecticut, USA

Michael P Steinmetz MD Chairman of Neurosciences, MetroHealth Medical Center, Cleveland, Ohio, USA; Associate Professor of Neurosurgery, Case Western Reserve University School of Medicine, Cleveland, Ohio, USA

Vartan S Tashjian MD Neurosurgeon, Department of Neurosurgery, Kaiser Permanente Medical Center – Fontana, Los Angeles, California, USA

Juan Torres-Reveron MD PhD Resident in Neurosurgery, Department of Neurosurgery, Yale University, New Haven, Connecticut, USA

R Shane Tubbs PhD PA-C Researcher, Children's of Alabama, Birmingham, Alabama, USA

Cheerag D Upadhyaya MD Fellow, Spine Surgery, Department of Neurological Surgery, University of California, San Francisco, California, USA

Shobhan Vachhrajani MD Neurosurgery Resident, Division of Neurosurgery, Hospital for Sick Children, University of Toronto, Toronto, Ontario, Canada

Alex Valadka MD Chief Executive Officer, Seton Brain and Spine Institute, Austin, Texas, USA

Gregory J Velat MD Clinical Lecturer, University of Florida, Department of Neurological Surgery, Gainesville, Florida, USA

Kenneth P Vives MD Associate Professor; Chief of Stereotactic and Functional Neurosurgery, Department of Neurosurgery, Yale University, New Haven, Connecticut, USA

Michael Y Wang MD FACS Professor of Neurological Surgery, Department of Neurological Surgery, University of Miami Miller School of Medicine, Miami, Florida, USA

John C Wellons III MD Associate Professor, Division of Neurosurgery; Division of Pediatric Neurosurgery, Children's of Alabama, University of Alabama Birmingham, Birmingham, Alabama, USA

Nicholas Wetjen MD Assistant Professor, Neurosurgeon, Mayo Clinic, Rochester, Minnesota, USA

Robert G Whitmore MD Chief Resident of Neurosurgery, Department of Neurosurgery, Hospital of the University of Pennsylvania, Philadelphia, Pennsylvania, USA; Wallace Clinical Trials Center, Greenwich, Connecticut, USA

Jau-Ching Wu MD Attending Surgeon, Department of Neurosurgery, Neurological Institute, Taipei Veterans General Hospital, Taiwan; School of Medicine, National Yang-Ming University, Taiwan

Jonathan Yun MD Resident, Department of Neurological Surgery, The Neurologic Institute of New York, Columbia University, New York, USA

Gregory J Zipfel MD Associate Professor of Neurological Surgery and Neurology; Co-Director, Stroke and Cerebrovascular Center, Washington University, St Louis, Missouri, USA

Abbreviations

5-ALA	5-aminolevulinic acid
AANS	American Association of Neurological Surgeons
ACAS	Asymptomatic Carotid Atherosclerosis Study
ACDF	anterior cervical discectomy and fusion
ACST	Asymptomatic Carotid Surgery Trial
ACT-1	Carotid Stenting versus Surgery of Severe Carotid Artery Disease and Stroke Prevention in Asymptomatic Patients (study)
ACTH	adrenocorticotrophic hormone
ADL	activities of daily living
AGF	autogenous growth factor
AHA	American Heart Association
AHRQ	Agency for Healthcare Research and Quality
AIBG	autologous iliac crest bone graft
AIS	antibiotic-impregnated shunt catheter
ALIC	anterior limbs of the internal capsules
ALIF	anterior lumbar interbody fusion
ANT	anterior nuclei of the thalamus
AOD	atlanto-occipital dislocation
ARIC	Atherosclerosis Risk in Communities (study)
ARUBA	A Randomized Trial of Unruptured Brain Arteriovenous Malformations
aSAH	aneurysmal subarachnoid hemorrhage
ASIA	American Spinal Injury Association
ATACH	Antihypertensive Treatment of Acute Cerebral Hemorrhage (study)
ATL	anterior temporal lobectomy
AVEEG	audio-video electroencephalography
AVM	arteriovenous malformation
BCNU	1,3-bis(2-chloroethyl)-1-nitrosourea
BDI	Beck Depression Inventory
BFMDRS	Burke-Fahn-Marsden Dystonia Rating Scale
BMP	bone morphogenetic protein
BP	blood pressure
CAPRIE	The Clopidogrel Versus Aspirin in Patients at Risk of Ischaemic Events (study)
CaRESS	Carotid Revascularization Using Endarterectomy or Stenting Systems (study)
CAS	carotid artery stenting
CAVATAS	Carotid and Vertebral Artery Transluminal Angioplasty Study
CBLP	chronic back and leg pain
CBTRUS	Central Brain Tumor Registry of the United States
CC	case-control study
CCB	calcium-channel blocker
CCNU	chloroethyl nitrosourea
CDC	Centers for Disease Control and Prevention
CEA	carotid endarterectomy
CHA	coralline hydroxyapatite
CHS	Cardiovascular Health Study
CI	confidence interval
CLBP	chronic low back pain

CM1	Chiari malformation type I
CM2	Chiari malformation type II
CMM	conventional medical management
CNS	Congress of Neurological Surgeons
COSS	Carotid Occlusion Surgery Study
CPC	choroid plexus cauterization
CPP	cerebral perfusion pressure
CPS	complex partial seizures
CREST	Carotid Revascularization Endarterectomy versus Stenting Trial
CRPS-I	complex regional pain syndrome type I
CS	case series
CSF	cerebrospinal fluid
CSM	cervical spondylotic myelopathy
CT	computerized tomography
CTA	computerized tomography angiography
DBM	demineralized bone matrix
DBS	deep brain stimulation
DC	decompressive craniectomy
DCI	delayed cerebral infarction
DDD	degenerative disc disease
DECRA	Decompressive Craniectomy (study)
DI	diffuse injury
DIND	delayed ischemic neurologic deficit
DPQ	Dallas Pain Questionnaire
DRG	Diagnosis-Related Group
DRI	Disability Rating Index
DSA	digital subtraction angiography
DVT	deep vein thrombosis
DWI	diffusion-weighted imaging
EAA	endocrine active adenoma
EC-IC	extracranial-intracranial
ECoG	electrocorticography
ECOG	Eastern Cooperative Oncology Group
ECST	European Carotid Surgery Trial
ED-5D	EuroQoL-Five Dimensions (questionnaire)
EEG	electroencephalography
EMG	electromyography
EORTC	European Organisation for Research and Treatment of Cancer
EPD	embolic protection device
ESIT	Endoscopic Shunt Insertion Trial
ET	essential tremor
ETV	endoscopic third ventriculostomy
EVA-3S	Endarterectomy versus Angioplasty in Patients with Severe Symptomatic Carotid Stenosis (study)
EVD	external ventricular drain
FBSS	failed back surgery syndrome
FDA	US Food and Drug Administration
FdUrd	5-fluoro-2'-deoxyuridine
FLAIR	fluid attenuation inversion recovery
FOS	functional outcome scores
GBM	glioblastoma multiforme
GCS	Glasgow Coma Scale
GDC	Guglielmi detachable coil

The Evidence for Neurosurgery

GH	growth hormone
GOS	Glasgow Outcome Scale
GPI	globus pallidus interna
GTR	gross total resection
HA	hydroxyapatite
HAM-D	Hamilton Depressive Scale
HDE	humanitarian device exemption
HR	hazard ratio
HRQoL	health-related quality of life
HSQ	Health Status Questionnaire
IA	intra-arterial
IAP	intra-carotid amygdalotomy procedure
ICD-9-CM	International Classification of Diseases, 9th Revision, Clinical Modification
ICH	intracerebral hematoma
ICP	intracranial pressure
ICSS	International Carotid Stenting Study
ICU	intensive care unit
IGF	insulin-like growth factor
INR	International Normalized Ratio
IQ	intelligence quotient
IRB	institutional review board
ISAT	International Subarachnoid Aneurysm Trial
ISS	Injury Severity Score
ISUIA	International Study of Unruptured Intracranial Aneurysms
ITG	inferior temporal gyrus
IUC	intrauterine closure
IV	intravenous
IVH	intraventricular hemorrhage
KPS	Karnofsky Performance Score
LBPR	Low Back Pain Rating Scale
LDL	low-density lipoprotein
LOS	length of stay
MA	meta-analysis
MASH	Magnesium in Aneurysmal Subarachnoid Hemorrhage (study)
MCA	middle cerebral artery
MCS	motor cortex stimulation
MDD	major depressive disorder
MEG	magnetoencephalography
MESCC	metastatic epidural spinal cord compression
MGd	motexafin gadolinium
MI	myocardial infarction
mJOA	modified Japanese Orthopedic Association (score)
MMC	myelomeningocele
MOMs	Management of Myelomeningocele Study
MPFS	malignant progression-free survival
MRA	magnetic resonance angiography
MRI	magnetic resonance imaging
mRS	modified Rankin Scale
MTG	middle temporal gyrus
MTLE	mesial temporal lobe epilepsy
MTLS	medial temporal lobe sclerosis
MTS	mesial temporal sclerosis
NASCET	North American Symptomatic Carotid Endarterectomy Trial

NCCTG	The North Central Cancer Treatment Group
NDI	Neck Disability Index
NFPA	non-functioning pituitary adenoma
NIH	National Institutes of Health
NIHSS	National Institutes of Health Stroke Scale
NOMASS	Northern Manhattan Stroke Study
NPRI	nicardipine prolonged-release implants
NSAID	non-steroidal anti-inflammatory drug
NSCLC	non-small-cell lung cancer
NSVD	normal spontaneous vaginal delivery
OCD	obsessive-compulsive disorder
ODI	Oswestry Disability Index
OEF	oxygen extraction fraction
OR	odds ratio
OS	overall survival
PAG	periaqueductal gray matter
PCS	physical component summary
PD	Parkinson's disease
PDQ	Parkinson's Disease Questionnaire
PEEK	polyether-etherketone
PET	positron emission tomography
PFS	progression-free survival
PICA	posterior inferior communicating artery
PIGD	postural instability and gait disturbance
PLF	posterolateral fusion
PLIF	posterior lumbar interbody fusion
PLL	posterior longitudinal ligament
PMMA	polymethylmethacrylate
PNC	postnatal closure
PPN	pedunculopontine nucleus
PROCESS	Prospective Randomized Controlled Multicenter Trial of the Effectiveness of Spinal Cord Stimulation
PVG	periventricular gray matter
QALY	quality-adjusted life-year
QoL	quality of life
RCT	randomized controlled trial
rFVIIa	recombinant activated factor VII
ROC	receiver operating characteristic
RR	relative risk
RSD	reflex sympathetic dystrophy
RTOG	Radiation Therapy Oncology Group
SA	selective amygdalohippocampectomy
SAH	subarachnoid hemorrhage
SAMMPRIS	Stenting vs. Aggressive Medical Management for Preventing Recurrent Stroke in Intracranial Stenosis (study)
SAPPHIRE	Stenting and Angioplasty with Protection in Patients at High Risk for Endarterectomy (study)
SBA	Spina Bifida Association
SBP	systolic blood pressure
SCI	spinal cord injury
SCLC	small-cell lung cancer
SCS	spinal cord stimulation
SEEG	stereoelectroencephalography
SF	Short Form (questionnaire)

The Evidence for Neurosurgery

sICD	symptomatic intracranial arterial disease
SISCOM	subtraction ictal SPECT data correlated with MRI
SIVMS	Scottish Intracranial Vascular Malformation Study
SOMI	sterno-occipital-mandibular immobilizer
SONIA	Stroke Outcomes and Neuroimaging of Intracranial Atherosclerosis (study)
SPACE	Stent-Supported Percutaneous Angioplasty of the Carotid Artery versus Endarterectomy (study)
SPECT	single photon emission computed tomography
SPORT	Spine Patient Outcomes Research Trial
SRS	stereotactic radiosurgery
SSYLVA	Stenting of Symptomatic Atherosclerotic Lesions in the Vertebral or Intracranial Arteries (study)
STA	superficial temporal artery
sTBI	severe traumatic brain injury
STG	superior temporal gyrus
STICH	Surgical Trial in Intracerebral Hemorrhage
STN	subthalamic nucleus
STR	subtotal resection
STSG	Spine Trauma Study Group
TASS	Ticlopidine Aspirin Stroke Study
TBA	transluminal balloon angioplasty
TBI	traumatic brain injury
TCD	transcranial Doppler
TCP	tricalcium phosphate
TIA	transient ischemic attack
TLE	temporal lobe epilepsy
TLIF	transforaminal lumbar interbody fusion
TLSO	thoraco-lumbo-sacral orthosis
TMZ	temozolomide
TNP	trigeminal neuropathic pain
tPA	tissue plasminogen activator
TSC	tethered spinal cord
TS-SAH	transsylvian selective amygdalohippocampectomy
TWSTRS	Toronto Western Spasmodic Torticollis Scale
UIA	unruptured intracranial aneurysm
UPDRS	Unified Parkinson's Disease Rating Scale
VAS	Visual Analogue Scale
VC/VS	ventral capsule/ventral striatum
VIM	ventral intermediate thalamic nucleus
VNS	vagus nerve stimulation
VP	ventriculoperitoneal
VPL	ventral posterolateral nucleus
VS	vestibular schwannoma
WAD	whiplash-associated disorders
WASID	Warfarin-Aspirin in Symptomatic Intracranial Arterial Disease (study)
WBRT	whole-brain radiation therapy
WFAQ	Waddell's Fear Avoidance Questionnaire
WFNS	World Federation of Neurosurgical Societies
WHO	World Health Organization
Y-BOCS	Yale-Brown Obsessive-Compulsive Scale

Foreword

Neurosurgery represents one of the most specialized arenas in modern medicine. Today, more than ever, patients with neurological disorders seek opinions from a variety of specialists and are often treated by teams of physicians. While consensus is often reached within institutions, regional variation is found between institutions. The lack of high quality clinical evidence contributes to this problem.

This textbook aims to examine some of the most controversial areas of neurological surgery by applying the current evidence to illuminate our understanding of the pathophysiology of each disease and the outcomes from surgical and non-surgical treatments. Today's neurosurgeon must be able to apply current evidence in the clinic to determine, for example:

- ◆ which degenerative lumbar spine should be fused, decompressed, or both, and which spine deformity should be corrected and to what extent?
- ◆ which aneurysm should be treated with endovascular and/or open vascular techniques?
- ◆ whether an acoustic neuroma should be treated, followed, removed, or irradiated?

The Evidence for Neurosurgery is a textbook that challenges current dogmas in many instances, provides an organized framework for understanding where current evidence can be applied clinically, and illustrates where gaps in the evidence exist and how these deficiencies may be filled in the future.

In the first chapter, "Clinical evidence", the reader should gain an understanding of the levels of clinical evidence and will learn what types of study designs are appropriate and in which situations. The textbook is divided into six further sections: Spinal neurosurgery, Functional neurosurgery, Tumors, Pediatric neurosurgery, Vascular neurosurgery and Neurotrauma. Statements in each chapter that are supported by evidence will be followed by the level of evidence and grade of recommendation (e.g. Level IIb evidence and Grade B recommendation would be depicted as [IIb/B]). In addition, the key points of each chapter are summarized in a table with the level of evidence and grade of recommendation. Each section's editors have provided a brief synopsis of the specific challenges within each field followed by chapters that provide the current evidence in areas where clinical uncertainty lies.

Zoher Ghogawala, MD
Ajit A. Krishnaney, MD
Michael P. Steinmetz, MD
H. Hunt Batjer, MD
Edward C. Benzel, MD

The Editors

Zoher Ghogawala, MD is the Charles A. Fager Chairman of Neurosurgery at Lahey Clinic in Burlington, Massachusetts and is Associate Professor of Neurosurgery at Tufts University School of Medicine in Boston. He also serves as the Director of the Wallace Clinical Trials Center, which focuses upon comparative effectiveness research at Greenwich Hospital in Greenwich, Connecticut. Dr. Ghogawala trained in neurosurgery at the Massachusetts General Hospital in Boston, Massachusetts. Dr. Ghogawala currently serves on the Executive Committee for the Congress of Neurological Surgeons as well as the AANS/CNS Joint Section on Disorders of the Spine and Peripheral Nerves. He also serves on the Board of Directors for the North American Spine Society as well as the Neuropoint Alliance (AANS). He leads multiple non-industry funded, peer-reviewed clinical trials that aim to understand the comparative effectiveness of neurosurgical procedures.

Ajit A Krishnaney, MD is a staff neurosurgeon at the Cleveland Clinic and holds appointments in the Department of Neurological Surgery, the Center for Spine Health and the Cerebrovascular Center. He obtained his medical degree from the University of Wisconsin. He trained in neurosurgery at the Cleveland Clinic. Following residency he completed a fellowship in complex spine surgery also at the Cleveland Clinic. His clinical interests include complex spine surgery, tumors of the spine and spinal cord, and disorders of the craniocervical junction.

Michael P Steinmetz, MD is Chairman of the Department of Neuroscience at MetroHealth Medical Center and Associate Professor of Surgery at Case Western Reserve University School of Medicine in Cleveland Ohio. He trained in neurosurgery at the Cleveland Clinic followed by a fellowship in complex spine surgery at the University of Wisconsin. Following fellowship he served on the faculty of the Department of Neurosurgery and Center for Spine Health at the Cleveland Clinic for seven years prior to his appointment as Chairman of Neurosciences at MetroHealth. His clinical interests and expertise are in complex spine surgery, spine trauma and spinal cord injury.

Hunt Batjer, MD is the Michael J. Marchese Professor and Chair of the Department of Neurological Surgery at Northwestern University Feinberg School of Medicine and Northwestern Memorial Hospital in Chicago. Dr. Batjer trained at the University of Texas Southwestern Medical Center under Drs. Clark and Duke Samson and later served a fellowship at the University of London Queens Square and the University of Western Ontario under Dr. Charles Drake. He is a Past President of the Congress of Neurosurgical Surgeons and the Society of University Neurosurgeons. He is past Chairman of the AANS/CNS Section on Cerebrovascular Disease. He has served as Director and later Chair of the American Board of Neurosurgical Surgery and is currently Chair of the ACGME Neurosurgical Residency Review Committee. He is also Chairman of the Board of the Interurban and President Elect of the Neurosurgical Society of America. He is also serving as a Director at large on the Board of Directors

in the AANS and Co-Chairs the NFL Committee on Head, Neck, and Spine Injuries. In 2011 he served as the Honored Guest of the Congress of Neurological Surgeons.

Edward C Benzel MD is Chairman of the Department of Neurosurgery at Cleveland Clinic, and Professor of Surgery at Cleveland Clinic Lerner College of Medicine of Case Western Reserve University (CCLCM of CWRU).

Previously, he was Chief of the Divisions of Neurosurgery at Louisiana State University ('82-'89), University of New Mexico ('89-'99) and at Lovelace Medical Center, Albuquerque, New Mexico ('93-'99). Dr. Benzel specializes in spinal biomechanics and spine surgery. He has contributed significantly to the body of literature in that field, written and edited over 20 books, and published well over 200 peer-reviewed manuscripts. In addition, he currently sits on the Editorial Review Boards of multiple journals. His career has also focused on physician education, having previously directed neurosurgery residency training programs in New Mexico and in Cleveland.

Acknowledgement

This work represents the collective effort of the leaders in the field of neurosurgery. We are especially grateful to each of the authors who systematically reviewed the literature and produced chapters that highlight the evidence to support best practice in each topic within our field.

Our Section Editors: Fred G Barker, II, MD (Tumors), Edward R Smith, MD (Pediatric neurosurgery), Alex Valadka, MD (Trauma), Bernard R Bendok, MD (Cerebrovascular), Michael P Steinmetz, MD (Spine), and Kenneth P Vives, MD (Functional) all worked to provide overall guidance to the authors in each subsection of neurosurgery and have each written separate introductions to clarify for the reader where the major challenges lie within their respective areas of expertise.

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