THE SOCIETY OF UNIVERSITY NEUROSURGEONS

Seattle

2014 ANNUAL MEETING

JULY 17-JULY 20, 2014

Platinum:
Globus Medical

Gold:
ELEKTA
Johnson & Johnson
DePuy&Codman
Zeiss

Silver:
Providence Medical

Seattle 2014

We are excited to welcome our SUNS members and guests to The Emerald City, Seattle, Washington. Seattle is one of the most beautiful and exciting cities in North America. It is a major costal seaport, cultural, recreational and commerce center. It is situated in the Pacific Northwest on an isthmus between the Puget Sound and Pacific Ocean. The Olympic Mountains and Rain Forest, to the West and Cascade Mountain Range to the East, form a ring of snow-capped peaks, breath taking waterways and greenery that make Seattle a lush and popular tourist destination. And, Seattle is the gateway to the wild wilderness of Alaska, via a single flight or one of the countless luxury cruises. The natural beauty of the region is staggering and you are visiting it during the most ideal month. The weather in July is typically mild (about 75 F) and dry with 15+ hours of sun, and hopefully little precipitation.

You will experience the eclectic ambience this liberal, fiercely independent and innovative city, as well as the collective friendliness of the citizens. We hope you will make the time to explore our music and art scene, and experience one of the many fun outdoor activities such as fishing, sailing, biking or hiking. This region is the birthplace to pioneering international corporations such as Microsoft, Amazon, Boeing, Starbucks, Nordstrom, Costco, and Weyerhaeuser to name a mere fraction. You will be able to explore Seattle's rich music heritage, past and present. Seattle nurtured the early careers of Jimi Hendrix, Quincy Jones, Earnestine Anderson, and Ray Charles. It is the birthplace of major rock movements such as Grunge, including the groups Nirvana, Pearl Jam and Soundgarden. The city boasts many live jazz, rock and folk music venues, a national symphony, a regional ballet and opera house and several repertory theaters. The museums are fascinating and range from Art: the Seattle Art Museum, Chihuly Glass Museum, Henry, and Frye, to Music: Experience Music Project: and Science: Pacific Science Center, and the Museum of Flight.

The Puget Sound is home to one of our country's most active fishing fleets, providing a wealth of salmon, halibut and Dungeness crab. And, Washington State enjoys an abundant harvest of apples, cherries, pears and raspberries. The Pike Place Market is the oldest continuously operated public farmer's market in the USA and offers everything from fresh produce, meats, fish, to flowers. And the Northwest's award winning wineries are beginning to rival the reputation and quality of the competition from around the world. The restaurants remain some of the most seductive and celebrated in the country boasting a unique Asian fusion influence, Pacific Northwest Seafood and locally grown crops. And, of course, you can get a great cup of coffee anywhere.

The University of Washington, one of the great public universities in our country, is thrilled to host you again, as it did over 30 years ago. We look forward to seeing you again as I welcome you to my adopted city.

Warm Regards,
Richard G. Ellenbogen, MD, FACS

Department of Neurological Surgery
Theodore S. Roberts Endowed Chair
University of Washington School of Medicine

Present Officers

President
Sander Connolly

President-Elect
Scientific Program Chair
Jacques Morcos

Vice President
Michael Levy

Secretary/Treasurer
Michael Wang

Member-at-large
Nelson Oyesiku

Historian
Ken Smith

Membership Committee
Franco DeMonte
Carlos David
Arun Amar

Future Site Committee
Charles Liu
Erol Veznedaroglu
Nick Boulis

Previous Meetings

~~~~~~1965~~~~~~
Montreal Neurological Institute
Montreal, QUE

~~~~~~1966~~~~~~
Duke University
Durham, NC

~~~~~~1967~~~~~~
University of Minnesota
Minneapolis, MN

~~~~~~1968~~~~~~
Upstate Medical Center
Syracuse, NY

~~~~~~1969~~~~~~
Massachusetts General Hospital
Boston, MA

~~~~~~1970~~~~~~
Baptist Memorial Hospital
Memphis, TN

~~~~~~1971~~~~~~
Albert Einstein College of Medicine
Bronx, NY

~~~~~~1972~~~~~~
University of British Columbia
Vancouver, BC

~~~~~~1973~~~~~~
Emory University
Atlanta, GA

~~~~~~1974~~~~~~
University of Texas Medical School
San Antonio, TX

~~~~~~1975~~~~~~
Mayo Clinic
Rochester, MN

~~~~~~1976~~~~~~
Jefferson Medical College
Philadelphia, PA

~~~~~~1977~~~~~~
Mayfield Neurological Institute
Cincinnati, OH

~~~~~~1975~~~~~~
Mayo Clinic
Rochester, MN

~~~~~~1976~~~~~~
Jefferson Medical College
Philadelphia, PA

~~~~~~1977~~~~~~
Mayfield Neurological Institute
Cincinnati, OH

~~~~~~1978~~~~~~
Medical College of Georgia
Augusta, GA

~~~~~~1979~~~~~~
University of Guadalajara
Guadalajara, MX

~~~~~~1980~~~~~~
University of Florida
Gainesville, FL

~~~~~~1981~~~~~~
University of Western Ontario
London, ONT

~~~~~~1982~~~~~~
University of Mississippi
Jackson, MS

~~~~~~1983~~~~~~
Duke University/University of NC
Durham/Chapel Hill, NC

~~~~~~1984~~~~~~
University of Washington
Seattle, WA

~~~~~~1985~~~~~~
University of Colorado
Denver/Vail, CO

~~~~~~1986~~~~~~
University of Louisville
Louisville, KY

~~~~~~1987~~~~~~
Medical College of Virginia
Richmond, VA

~~~~~~1988~~~~~~
University of Tubingen
Tubingen, FRG

~~~~~~1989~~~~~~
University of Toronto
Toronto, ONT

~~~~~~1990~~~~~~
Louisiana State Univ. Medical Center
New Orleans, LA

~~~~~~1991~~~~~
Tufts New England Medical School
Boston, MA

~~~~~~1992~~~~~~
Dartmouth Medical School
Woodstock, VT

~~~~~~1993~~~~~~
St. Louis University Medical School
St. Louis, MO

~~~~~~1994~~~~~~
University of Lyon
Lyon, France

~~~~~~1995~~~~~~
Thomas Jefferson Medical School
Philadelphia, PA

~~~~~1996~~~~~~
University of Southern California
Los Angeles, CA

~~~~~~1997~~~~~~
University of Michigan
Ann Arbor, MI

~~~~~~1998~~~~~~
University of Tennessee
Memphis, TN

~~~~~~1999~~~~~~
University of Melbourne
Melbourne, Australia

~~~~~~2000~~~~~~
Havard Medical School/
Brigham & Women's
Boston, MA

~~~~~~2001~~~~~~
Oregon Health Sciences University
Portland, OR

~~~~~~2002~~~~~~
Northwestern University/ Chicago
Evanston, IL

~~~~~~2003~~~~~~
Columbia Presby. Med Center/
NY Presby. Hospital
New York, NY

~~~~~~2004~~~~~~
Karolinska Institute
Stockholm, Sweden

~~~~~~2005~~~~~~
Wake Forest University
School of Medicine
Winston-Salem, NC

~~~~~~2006~~~~~~
University of California – San Diego
Del Mar, CA

~~~~~~2007~~~~~~
National Hospital for Neurology
and Neurosurgery
London, England

~~~~~~2008~~~~~~
University of California
San Francisco, CA

~~~~~~2009~~~~~~
Sapienza University
Rome, Naples & Capri, Italy

~~~~~~2010~~~~~~
University of Miami
Miami, Florida

~~~~~~2011~~~~~~
Istanbul, Turkey

~~~~~~2012~~~~~~
Emory University
Atlanta, Georgia

~~~~~~2013~~~~~~
Carlos Haya University
Malaga, Spain

Past Presidents

~~~~~~1965~~~~~~
James T. Robertson, MD

~~~~~~1966~~~~~~
George T. Tindall, MD

~~~~~~1967~~~~~~
Robert G. Ojemann, MD

~~~~~~1968~~~~~~
Charles L. Branch, MD

~~~~~~1969~~~~~~
Jim Story, MD

~~~~~~1970~~~~~~
Herbert Lourie, MD

~~~~~~1971~~~~~~
Byron Pevehouse, MD

~~~~~~1972~~~~~~
Kenneth Shulmann, MD

~~~~~~1973~~~~~~
Darton Brown, MD

~~~~~~1974~~~~~~
Ellis Keener, MD

~~~~~~1975~~~~~~
Robert Hardy, MD

~~~~~~1976~~~~~~
Phanor Perot, MD

~~~~~~1977~~~~~~
Gordon Thompson, MD

~~~~~~1978~~~~~~
Lucien R. Hodges, MD

~~~~~~1979~~~~~~
Robert White, MD

~~~~~~1980~~~~~~
Robert Grossman, MD

~~~~~~1981~~~~~~
Stewart Dunsker, MD

~~~~~~1982~~~~~~
Marshall Allen, MD

~~~~~~1983~~~~~~
Ian Turnbull, MD

~~~~~~1984~~~~~~
Henry Garretson, MD

~~~~~~1985~~~~~~
Harold F. Young, MD

~~~~~~1986~~~~~~
Robert Smith, MD

~~~~~~1987~~~~~~
Kenneth R. Smith, Jr. MD

~~~~~~1988~~~~~~
Willis Brown, MD

~~~~~~1989~~~~~~
Glenn W. Kindt, MD

~~~~~~1990~~~~~~
Salvador Gonzales-Cornejo, MD

~~~~~~1991~~~~~~
Michael L.J. Apuzzo, MD

~~~~~~1992~~~~~~
William A. Buchheit, MD

~~~~~~1993~~~~~~
Alan R. Hudson, MD

~~~~~~1994~~~~~~
Robert Maxwell, MD

~~~~~~1995~~~~~~
Peter L. Black, MD

~~~~~~1996~~~~~~
William Shucart, MD

~~~~~~1997~~~~~~
Ronald F. Young, MD

~~~~~~1998~~~~~~
David W. Roberts, MD

~~~~~~1999~~~~~~
Charles S. Hodge, Jr. MD

~~~~~~2000~~~~~~
John E. McGillicuddy, MD

~~~~~~2001~~~~~~
H. Hunt Batjer, MD

~~~~~~2002~~~~~~
Philip Stieg, PhD, MD

~~~~~~2003~~~~~~
Robert Rosenwasser, MD

~~~~~~2004~~~~~~
Robert Breeze, MD

~~~~~~2005~~~~~~
Kim Burchiel, MD

~~~~~~2006~~~~~~
Jon Robertson, MD

~~~~~~2007~~~~~~
Carl Heilman, MD

~~~~~~2008~~~~~~
Robert Solomon, MD

~~~~~~2009~~~~~~
Jeffrey Bruce, MD

~~~~~~2010~~~~~~
John Wilson, MD

~~~~~~2011~~~~~~
Anil Nanda, MD

~~~~~~2012~~~~~~
Thomas Origitano, MD

~~~~~~2013~~~~~~
Neil Kitchen, MD


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2014 Meeting Attendees

SUN Members

Albuquerque, Felipe, MD.
Amar, Arun, MD.
Anderson, Richard, MD.
Boulis, Nicholas, MD.
Breeze, Robert, MD.
Choi, David, MD.
Chiocca, Ennio, MD.
Connolly, Sander, MD.
Ellenbogen, Richard, MD.
Foley, Kevin, MD.
Grossman, Robert, MD.
Jimenez, David, MD.
Kaiser, Michael, MD.
Kitchen, Neil, MD.
Krishnamurthy, Satish, MD.
Liu, Charles, MD.
McCutcheon, Ian, MD.
McGillicuddy, John, MD.
McKhann, Guy, MD.
Michael, Madison, MD.
Morcos, Jacques, MD.
Nanda, Anil, MD.
Narayan, Raj, MD.
Ojemann, George, MD.
Origitano, Thomas, MD.
Prestigiacomo, Charles, MD.
Roberts, David, MD.
Sisti, Michael, MD.
Smith, Kenneth, MD.
Solomon, Robert, MD.
Varsos, Vassilis, MD.
Veznedaroglu, Erol, MD.
Wang, Michael, MD.
Yoshor, Daniel, MD.

Members' Guests

Baskaya, Mustafa, MD.
Hoh, Daniel, MD.
(Invited by Dr. Wang)

Erkmen, Kadir, MD.
Hasan, David, MD.
(Invited by Dr. Nanda)

Baskaya, Mustafa, MD.
Preul, Mark, MD.
Tymianski, Michael
(Invited by Dr. Morcos)
Floyd, John, MD.
(Invited by Drs. Jimenez/DeMonte)

Grant, Gerry, MD.
(Invited by Dr. Ellenbogen)

Khalessi, Alexander, MD.
(Invited by Drs. Amar/Liu)

Liebman, Kenneth, MD.
(Invited by Dr. Veznedaroglu)

Mack, William, MD.
(Invited by Dr. Amar)

Papanastassiou, Alexander, MD.
(Invited by Dr. Jimenez)

Shekar, Kurpad, MD.
(Invited by Dr. Liu)

Chin, Larry MD.
(Invited by Dr.Krishnamurthy)

Ogden, Alfred
(Invited by Dr.Kaiser)

Distinguished Service Award

Robert A. Solomon, MD

Professor, Department of Neurosurgery
Byron Stookey Professor and Chairman
Department of Neurological Surgery
Columbia University College of Physicians and Surgeons
New York Presbyterian Hospital

Robert Solomon grew up and attended high school in Baltimore, Maryland. He graduated with a bachelor's degree in molecular biophysics and biochemistry from Yale University in 1976. A 1980 graduate of the John's Hopkins University School of Medicine, Dr. Solomon has spent his entire professional career uninterrupted at the Neurological Institute of New York, jointly affiliated with Columbia University College of Physicians and Surgeons and New York Presbyterian Hospital. In September 1997 he was named the Byron Stookey Professor and Chairman of the Department of Neurological Surgery.

Dr. Solomon has carried out extensive research in cerebrovascular diseases. Using small animal models of subarachnoid hemorrhage, cerebral vasospasm, and stroke, he studied the blood flow changes in the brain microcirculation that accompany ruptured cerebral aneurysms, and investigated the value of hypothermia in protecting the brain from stroke. These finding were used to develop a clinical program of hypothermia and pharmacological brain protection during surgical approaches to cerebrovascular diseases.

Clinical research has been focused on the management of patients with brain aneurysms and arteriovenous malformations.Most significantly, Dr. Solomon's work in the 1980's contributed to the identification of the blood volume deficit that occurred in patients that developed delayed cerebral ischemia after aneurysmal subarachnoid hemorrhage. Current interests include the public health issues and population studies related to endovascular and surgical treatment of unruptured aneurysms, arteriovenous malformations, and carotid artery stenosis.

Dr. Solomon was a past Chairman of the American Board of Neurological Surgeons, and is the past President of several organizations including: The Academy of Neurological Surgery, The New York State Neurosurgical Society, and The Society of University Neurosurgeons. He is currently the Vice President of the Society of Neurological Surgeons.

Bob is an avid golfer and family man. He and his wife Barbara have two adult children: Reece and Hudson, and a Pomeranian named Georgia.

Special Speakers

Gerald Grinstein

Business Visionary and Board of Trustees of the University of Washington Foundation.

Jerry Grinstein was the CEO of Delta Air Lines from 2004 to 2007. He had been a director of Delta Air Lines since 1987 and served as Delta's non-executive chairman from August 1997 until October 1999.

Prior to taking on the CEO role of Delta, Jerry served as non-executive chairman of Agilent Technologies from 1999 through November 2002. He retired as chairman and CEO of Burlington Northern Inc. in 1995. While in that position he oversaw the company's acquisition of Santa Fe Pacific Corp., which created the nation's largest railroad.

Before joining BNI, Jerry served as president and CEO of Western Airlines, Inc., from 1984 through March 1987, when Western merged with Delta.

Jerry was a partner in the law firm Preston, Thorgrimson, Ellis & Holman in Seattle from 1969-1983. His prior career includes serving as Chief Counsel to the U.S. Senate Commerce Committee, Counsel to the Merchant Marine & Transportation subcommittee and Administrative Assistant to U.S. Senator Warren G. Magnuson.

Jerry is currently a Strategic Director at Madrona Venture Group. He is a Trustee of the Henry M. Jackson Foundation and a board member of Long Live the Kings, The University of Washington Foundation, the William D. Ruckelshaus Center and past Chair of the University of Washington Medical Foundation.

A Native of Seattle, Jerry graduated from Yale College in 1954 and Harvard Law School in 1957. He and his wife Lyn reside in Seattle.

Ed Lein, Ph.D

Senior Investigator, Allen Institute for Brain Science

Dr. Lein is a Senior Investigator at the Allen Institute for Brain Science where for the past 10 years he has provided scientific guidance and leadership for the creation of large-scale web based gene expression atlases of the mammalian brain as online resources for the scientific community. He was part of the team that generated the inaugural Allen Mouse Brain Atlas, and led production of the Brain Span Atlas of the Developing Human Brain, and the NIH Blueprint Non-Human Primate Atlas. He is now spearheading the human cell types project, which aims to build upon these foundational gene expression studies in human brain by developing and implementing methods for the quantitative phenotypic analysis of individual cells of the human neocortex.

As a pioneering scientific effort, The Allen Brain Atlases were an experiment on a massive scale. Their development faced a combination of great technical challenges and a non-traditional open research model, and encountered many hurdles on the path to completion and community adoption. Having overcome these challenges, however, each Atlas is now a fundamental tool for neuroscientists worldwide and has set the stage for the creation of other similar open resources.
Dr. Edward Lein received his B.S. in biochemistry from Purdue University and his Ph.D. in neurobiology from the University of California at Berkeley. His postdoctoral work in the laboratory of Dr. Fred Gage at the Salk Institute for Biological Studies focused on molecular profiling of specific hippocampal and neocortical cell types and the generation of molecular genetic tools for functional manipulation of specific neuronal subtypes. His particular interests include the use of large-scale gene expression data to map functional brain divisions, define specific neuronal subtypes, and compare cellular-level gene expression patterns from rodents to humans to identify molecular pathways unique to humans. He has an exceptionally strong record of academic involvement including articles in high value peer-reviewed journals, including field-leading articles in Nature, Nature Neuroscience, Cell, Neuron, and The New England Journal of Medicine. As an indication of his international standing, over 20% of Dr. Lein's publications have appeared in Nature.

Meeting Schedule

Thursday, July 17,2014

10:30am-12:00pm:	Registration	
12:00 - 1:30pm:	Lunch Buffet	Metropole Room, Fairmont
1:30 - 1:50pm:	Meet the Exhibitors	
1:50- 5:00pm:	**Scientific Session I At Fairmont Metropole Room**	
	Moderators: Sander Connolly MD. & Michael Wang MD.	
1:50 - 2:00 pm:	Introduction	Ellenbogen, Richard
2:01 - 2:10 pm:	The surgical treatment of pituitary carcinoma: the M. D. Anderson experience.	McCutcheon, Ian
2:11 - 2:20 pm:	From bench to brain: A dual phase 1/2, investigator initiated study to determine the maximum tolerated dose, safety, and efficacy of 186Rhenium nanoliposomes (186RNL) in recurrent glioblastoma	Floyd, John
2:21 - 2:30 pm:	Prospective evaluation of the utility of intraoperative fiber-optic confocal laser endomicroscopy in patients with brain neoplasms using fluorescein sodium: experience with 74 cases	Preul, Mark
2:31 - 2:40 pm:	Neuroanatomical basis of microsurgical approaches to lesions in eloquent brain regions	Baskaya, Mustafa
2:41 - 2:50 pm:	Forebrain and spinal cord tumor histology and growth are determined by unique microenvironmental responses to paracrine stimulation in PDGF driven models of glioma	Ogden, Alfred
2:51 - 3:00 pm:	Discussion	
3:01 - 3:10 pm:	Gliosarcomas: management and outcome. A retrospective study.	Varsos, Vassilis
3:11 - 3:20 pm:	Osmotically active macromolecules are cleared through blood brain barrier: A pharmacological target for hydrocephalus?	Krishnamurthy, Satish
3:21 - 3:30 pm:	Long-term effects of rigid instrumentation and fusion at the craniovertebral junction in young children	Anderson, Richard
3:31 - 3:40 pm:	Translaminar screws are safe and effective in lumbar fusion surgery	Chin, Larry

3:41 - 3:50 pm:	Radiographic Predictors of Proximal Junctional Kyphosis after Long Segment Thoraco-Lumbar Fusion for Adult Spinal Deformity	Hoh, Daniel
3:51 - 4:00 pm:	Discussion	
4:01 - 4:10 pm:	A Stereotactic Atlas of the Human Lumbar and Sacral Spinal Cord	Grossman, Robert
4:11 - 4:20 pm:	Optimization of a Novel Cell Therapy for Degenerative Disc Disease Using a Porcine Model	Foley, Kevin
4:21 - 4:30 pm:	Neuronavigation accuracy in epilepsy surgery with surface registration versus bone fiducial registration	Papanastassiou, Alexander
4:31 - 4:40 pm:	Google Maps. Street View, and Intracranial Navigation	Roberts, David
4:41 - 4:50 pm:	Discussion	
5:00 - 6:30 pm:	**Executive Board Meeting (EC Members only)**	**Cabinet Room, Fairmont**
6:30 - 9:30 pm:	**Pacific NW Reception/Wine Tasting**	**Garden Room, Fairmont**

Friday, July 18, 2014

6:30-9:00am:	Breakfast at the Fairmont Hotel (all attendees)	**Garden Room, Fairmont**
7:30 am:	Board shuttles at Fairmont to Harborview Medical Center	
8:00am-12:00pm:	Registration	**Windsor Room**
8:00-11:30 am:	**Scientific Session I I At Harborview Medical Center**	**R&T Auditorium**
8:01 - 8:10am:	Welcome & Department of Neurological Surgery Overview	Ojemann, George & Ellenbogen, Richard
8:11 - 8:20am:	History of Neurological Surgery in the Northwest	Loeser, John
8:21 - 8:30am:	Minimally Invasive Skull Base Program	Ferreira, Manuel
8:31 - 8:40am:	Technology, Innovation and Entrepreneurship	Browd, Samuel
8:41 - 8:50am:	Aneurysm Research and Harborview Medical Center	Kim, Louis
8:51 - 9:00am:	Intracranial Pressure Monitoring and Research in Latin America/Neurotrauma at Harborview	Chesnut, Randall

9:01 - 9:10am:	Brain Computer Interface/Neural-Engineering at UW	Ko, Andrew
9:11-9:20am:	Solid Tumor Translational Research at the Fred Hutchinson Cancer Research Center	Holland, Eric
9:21-9:30am:	AVM /Skull Base Program	Sekhar, Laligam
9:31-9:40am:	Stem Cell Research at South Lake Union	Horner, Philip
9:41-9:50am:	Awake Mapping and Malignant Tumor program/uwmc	Silbergeld, Daniel
9:51-10:00am:	Center for Integrative Brain Research at the Seattle Children's Research Institute	Ramirez, Jan "Nino"
10:01-10:15 am:	Break	
10:16-10:25 am:	Distinguished Service Award Presented to Dr. Robert Solomon	Connolly, Sander
10:26-10:30 am:	Introduction of SUN President	McKhann, Guy
10:31-11:00 am:	Presidential Address	Connolly, Sander
11:01-11:30 am:	Guest Speaker, Affiliate Assistant Professor in the Department of Physiology and Biophysics at the University of Washington, Allen Institute for Brain Science	Lein, Ed
11:45 am:	Board shuttles back to Fairmont	
12:00 - 1:00 pm:	Lunch at the Fairmont Hotel	**The Garden Room**
1:15 - 1:45 pm:	Board shuttles at Fairmont to Museum of Flight	
2:00 - 4:00pm:	Tour Museum of Flight	
4:25pm:	Board shuttles back to Fairmont	
4:45 - 5:30 pm:	Short break	
5:30 pm	Board shuttles at the Fairmont to Pier 56	
6:00-7:00pm	Docking begins on vessel Royal Argosy	
7:00-9:30pm	**Dinner Cruise on Royal Argosy**	
9:45pm	Board shuttles back to Fairmont	

Spouses/Children

10:00-11:30am **Duck Tour** (9:45am Roundtrip from Fairmont Hotel)

Saturday, July 19, 2014

6:30 - 9:00 am:	Breakfast at the Fairmont Hotel (Guests and Spouses)	**Garden Room, Fairmont**
7:00-8:00am	Business Meeting - Including Breakfast (Members only)	**Congress Room, Fairmont**
8:00-11:30am:	**Scientific Session I I I At Fairmont**	**Metropole Room**
	Moderators: Jacques Morcos MD. & Charles Liu MD.	
8:01 - 8:10 am:	Aggressive surgical resection is the treatment of choice for symptomatic aggressive vertebral hemangiomas.	Choi, David
8:11 - 8:20 am:	Gunshot wounds to the spine: the role of decompressive laminectomy	Azevedoh, Hildo
8:21 - 8:30 am:	High cervical diffusion tensor imaging (hcDTI) metrics, rostral to the injury site	Kurpad, Shekar
8:31 - 8:40 am:	Shower of Microemboli following skull base fracture	Bristol, Ruth
8:41 - 8:50 am:	Myeloperoxidase as a Screening Biomarker for Human Cerebral Aneurysms	Hasan, David
8:51 - 9:00 am:	Discussion	
9:01 - 9:10 am:	Bypassing the Emergency Room in the treatment of acute stroke	Liebman, Kenneth
9:11 - 9:20 am:	Intraarterial (IA) Therapy of Cerebral Vasospasm: Comparison of Single Agent vs Multiple Agent Infusion	Erkmen, Kadir
9:21 - 9:30 am:	Balloon Remodeling of Complex Anterior Communicating Artery Aneurysms: Technical Considerations and Complications	Albuquerque, Felipe
9:31 - 9:40 am:	Multidisciplinary management of unruptured anterior circulation aneurysms by open minicraniotomy or endovascular therapy: Analysis of costs and outcomes.	Tymianski, Mike
9:41 - 9:50 am:	Evaluation of Time to aneurysm treatment following subarachnoid hemorrhage: comparison of patients treated with clipping versus coiling	Mack, William
9:51 - 10:00 am:	Discussion	
10:01 - 10:10 am:	Break with exhibitors	

10:11 - 10:20 am:	Efficacy of facial nerve-sparing approach in patients with cerebellopontine angle meningiomas.	Sisti, Michael
10:21 - 10:30 am:	Cavernous hemangiomas of the internal auditory canal and cerebellopontine angle	Link, Michael
10:31 - 10:40 am:	5-year Bibliometric Profiles for 103 U.S. Neurosurgical Residency Program	Michael, Madison
10:41 - 10:50 am:	The Mythology of Neurosurgical Procedures	Nanda, Anil
10:51 - 11:00 am:	The Economic Realities of Neurosurgical CME: It is Friday and Sunday is Coming. A view from the other side of the fence.	Origitano, Thomas
11:01 - 11:10 am:	Discussion	
11:11 - 11:15 am:	Introduction of Jerry Grinstein	Ellenbogen, Richard
11:16 - 11:45 am:	Guest Speaker, CEO of Delta Air Lines	Gerald Grinstein

from 2004 to 2007.

11:45am-12:45pm:	Lunch at the Fairmont Hotel	**Garden Room**
12:45pm:	Board shuttles at Fairmont to Pike Place Market	
1:15-2:45pm:	Walking Tour of Pike PlaceMarket	**Ghost Alley Espresso** **1499 Lower Post Alley**
3:00pm:	Board shuttles back to Fairmont	
3:30-4:45 pm:	Free time	
5:00pm:	Board shuttles at Fairmont to Seattle City Center	
5:30-6:30pm	Tour Space Needle	
6:30-7:00pm	Tour Chihuly Garden of Glass	
7:00-10:00pm	Gala dinner at Chihuly Glass House	
9:15pm	**Board shuttle back to Fairmont for those who want to leave early**	
10:15pm	Board shuttles back to Fairmont	

Spouses/Children

10:00-11:30am **Seattle Art Museum Tour**
(9:30am Roundtrip from Fairmont Hotel)

Sunday, July 20 , 2014

6:30-9:30 am:	Breakfast at the Fairmont Hotel	**The Spanish Foyer**

Learning Objectives

Upon completion of this CME activity, the participant should be able to:

- Discuss current practice patterns with regards to the symptomatology, diagnosis, treatment methods and complication avoidance with respect to the entire spectrum of neurosurgi cal conditions and allied specialties in the clinical and basic neurosciences.
- Review real clinical cases and specific treat ment methods that are justified and explained by recognized world leaders in the field.
- Describe the most recent and future trends in neurosurgery around the world.
- Identify effective program innovations and models from experts around the world.

Accreditation/ Continuing Medical Education (CME)

This activity has been planned and implemented in accordance with the accreditation requirements and policies of the Accreditation Council for Continuing Medical Education (ACCME) through the joint providership of the AANS and the Society of University Neurosurgeons. The AANS is accredited by the ACCME to provide continuing medical education for physicians.

The AANS designates this live activity for a maximum of 9.75 *AMA PRA Category 1 Credits*™. Physicians should claim only the credit commensurate with the extent of their participation in the activity.

Joint Providership Disclaimer

The material presented at the annual meeting of the Society of University Neurosurgeons (SUN) has been made available by the SUN and the AANS for educational purposes only. The material is not intended to represent the only, nor necessarily the best, method or procedure appropriate for the medical situations discussed, but rather it is intended to present an approach, view, statement, or opinion of the faculty, which may be helpful to others who face similar situations.

Neither the content (whether written or oral) of any course, seminar or other presentation in the program, nor the use of a specific product in conjunction therewith, nor the exhibition of any materials by any parties coincident with the program, should be construed as indicating endorsement or approval of the views presented, the products used, or the materials exhibited by the SUN and jointly provided by the AANS, or its Committees, Commissions, or Affiliates.

Neither the AANS nor the SUN makes any statements, representations or warranties (whether written or oral) regarding the Food and Drug Administration (FDA) status of any product used or referred to in conjunction with any course, seminar or other presentation being made available as part of the annual meeting of the Society of University Neurosurgeons (SUN). Faculty members shall have sole responsibility to inform attendees of the FDA status of each product that is used in conjunction with any course, seminar or presentation and whether such use of the product is in compliance with FDA regulations.

Educational Format

Didactic lectures, case presentations/discussions, panel discussions, and oral paper presentations

Disclosure Information

The AANS and *the Society of University Neurosurgeons* control the content and production of this CME activity and attempt to ensure the presentation of balanced, objective information. In accordance with the Standards for Commercial Support established by the Accreditation Council for Continuing Medical Education (ACCME), faculty, abstract reviewers, paper presenters/authors, planning committee members, staff, and any others involved in planning the educational content and the significant others of those mentioned must disclose any relationship they or their co-authors have with commercial interests which may be related to their content. The ACCME defines "relevant financial relationships" as financial relationships in any amount occurring within the past 12 months that create a conflict of interest.

Those who have disclosed a relationship* with commercial interests are listed below:

Name	Disclosure	Type of Relationship*
Robert Grossman, MD	InSightec	Honorarium
John Loeser, MD	Inspirion	Consultant Fee
William J. Mack, MD, MS	Penumbra, Inc.	Consultant Fee
T.C. Origitano, MD	Stryker	Industry Grant Support
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Name
Felipe C. Albuquerque, MD
Mustafa Baskaya, MD
*E. Sander Connolly, Jr., MD
Kadir Erkmen, MD
David Hasan, MD
Daniel Hoh, MD
Eric C. Holland, MD, PhD
Andrew Ko, MD
Satish Krishnamurthy, MD
Michael J. Link, MD
*L. Madison Michael, MD
*Jacques Morcos, MD
George Ojemann, MD
Alexander M, Papanastassiou, MD
Robert C. Rostomily, MD
Daniel Silbergeld, MD
Michael Sisti, MD
Vassilis Varsos, MD

*educational content planners

Abstracts

The surgical treatment of pituitary carcinoma

McCutcheon, Ian, MD.
MD Anderson Cancer Center

Introduction:
Pituitary carcinomas are characterized by distant metastases derived from a primary tumor originating in the pituitary gland. These rare, invasive lesions are difficult to treat and an optimal therapeutic strategy has not yet been established.

Methods:
Retrospective review was conducted of patients with pituitary carcinoma (n=12) treated at the MD. Anderson Cancer Center between 1994 and 2013.

Results:
All patients were initially diagnosed with pituitary adenoma at prior surgery. Mean latency from diagnosis of adenoma to diagnosis of carcinoma was 5.4 years. Patients had metastatic disease confined to the craniospinal axis (n=7), systemic metastases only (n=2), or both (n=1). Systemic metastases were seen only in liver and bone. Locations of craniospinal metastasis included cervical and lumbar vertebrae, thoracic intradural space, and dura of the middle fossa, posterior fossa, and spine. One patient had leptomeningeal dissemination. More patients had tumors secreting ACTH (n=8) than other hormones (prolactin, LH, or FSH). Mean MIB-1 labeling index was 15.7% (range, 0.4-40%). Seven patients were treated with temozolomide. Eight patients died from disease progression. Mean time from diagnosis of carcinoma to death was 3.5 years (range, 1-10 years). Of the four patients who remain alive, mean follow-up is 42 months.

Conclusion:
Pituitary carcinomas derive from “benign” pituitary adenomas. Although atypical features in the adenoma may presage malignant transformation, several patients lacked atypical histology. Current management approaches are inadequate at controlling progression of the carcinoma phenotype. More research is needed to identify molecular markers for malignant transformation in pituitary adenomas.

From Bench to Brain: A Dual Phase 1/2, Investigator Initiated Study to Determine the Maximum Tolerated Dose, Safety, and Efficacy of 186Rhenium Nanoliposomes (186RNL) in Recurrent Glioblastoma

Floyd, John, MD.
University of Texas Health Science Center at San Antonio

Glioblastoma arises from an astrocytic cell origin and is the most aggressive brain tumor in adults. Annually, over 13,000 new cases are diagnosis, with dismal survival, 29.3 % at one year, and 3.3% at 5 years. Poor survival is due to multiple factors, most notable, the inability of chemotherapy to pass through the blood brain barrier (BBB). Given the grave prognosis with this incurable and uniformly fatal disease, novel strategies therapeutic agents are needed.

One of the most effective methods of locally delivering therapeutic agents and bypassing the BBB, has been convection enhanced drug delivery. CED relies on bulk flow, or a small hydrostatic pressure gradient, to distribute infusate through the interstitial spaces of the central nervous system (CNS) and does not rely on diffusion. The state of the art flow CED catheters are highly engineered devices to maximize drug delivery to the tumor by minimizing the deforming force on the target during infusion, minimizing reflux at the tip of the catheter while maintaining a pressure gradient at the tip to create bulk flow.

Rhenium -186 (186Re) (half life 90hours) is a reactor produced, beta particle emitting isotope with great potential for medical therapy. The average 186Re beta particle path length in tissue of 1.8 mm and is ideal for treatment of solid tumors. However, a carrier is needed to deliver the isotope to the brain and maintain its localization at the desired site, as otherwise it would quickly disperse and be carried away from the site of injection by the circulatory system.

Liposomes are spontaneously forming lipid nanoparticles. The most useful size range for drug carrier applications is 80-100 nm. Liposomes of this size are small enough to move through interstitial tumor tissue during CED administration but large enough to prevent direct absorption by tumor vasculature. At UTHSCSA, researchers have pioneered a method for the labeling of nanoliposomes with radiotherapeutic rhenium radionuclides to very high levels of specific

activity (186 RNL). This novel approach uses a specially developed molecule known as BMEDA-2 to chelate with 186Re and carry it into the interior of a liposome where it is irreversibly trapped. This lipid nanocarrier is an essential component for radionuclide retention. The ability to treat the whole tumor is also greatly enhanced by the 2 mm average path length of the beta particle radiation, which compensates for mild inhomogeneities in the CED dispersion of the nanoparticles within the tumor. The 2 mm path length means that therapy delivered to one cell has the potential of moving through 80 cell diameters since an average cell diameter is 25 microns (25 x 80 cell diameters = 2 mm path length).

This study is a single center, sequential cohort, open-label, dose-escalation study of the safety, tolerability, and distribution of 186RNL given by convection enhanced delivery to patients with recurrent or progressive malignant glioma after standard surgical, radiation, and/or chemotherapy treatment. The study uses a modified rapid dose-escalation design. The starting dose will be 60 Gy. Dose escalation by dose-doubling will be done for 3 dose levels (i.e. 60, 120, 240 Gy), followed by a modified Fibonacci dose escalation scheme (i.e. dose increases of 67%, 50%, 40% and 33%) thereafter for each dose level. Dose escalation will progress until a maximum tolerated dose (MTD) is reached. A total of up to 14 patients may be treated at the MTD to further assess the safety and tolerability of 186RNL, the intratumoral distribution of 186RNL at the MTD, and the preliminary anti-tumor activity of 186RNL in patients with malignant glioma.

Prospective evaluation of the utility of intraoperative fiber-optic confocal laser endomicroscopy in patients with brain neoplasms using fluorescein sodium: experience with 74 cases

Mark C. Preul MD.[1]

Nikolay L. Martirosyan, MD[1]*,Jennifer M. Eschbacher, MD*[2]
Jay D. Turner MD, PhD[1]*, Ali M. Elhadi, MD, PhD*[1]
Robert F. Spetzler, MD[1]*, Peter Nakaji, MD*[1]
Mark C. Preul MD[1]
[1]Division of Neurological Surgery,[2]Division of Neuropathology, Division of Neurological Surgery, Barrow Neurological Institute, St. Joseph's Hospital and Medical Center, Phoenix, Arizona, 85013, USA

OBJECTIVE:
Histoological analysis of frozen sections is currently the mainstay for providing tissue diagnosis during resection of intracranial neoplasms and for evaluating tumor margins.For this study, we sought to evaluate the utility of in vivo confocal endomicroscopy to provide histologic information during resection of human brain tumors.

METHODS:
Surgical resection of intracranial neoplasms was performed in seventy-four patients (31 male) mean age 47.5 years (range 18-81 years). Confocal endomicroscopy. using fluorescein Sodium (FNa) was utilized intraoperatively in all patients. In addition, several tissue samples were analyzed with the endoscope in an ex vivo fashion. For direct comparison, samples from matched areas were acquired for routine histological analysis. The research team included a neuropathologist, two neurosurgeons, a confocal engineer, and two medical imaging scientists. Histopathologic features of corresponding confocal and hematoxylin and eosin images were reviewed for each case. Confocal images were classified as informative and non-informative.

RESULTS:
Confocal images were obtained for each patient. Mean procedure time was 15.7 minutes (range 3-73 min). A total 20,734 confocal images were correlated with 267 biopsy specimens from 74 procedures. Percent of informative in vivo or ex vivo images did not vary by diagnosis. Endomicroscopic imaging of FNa distribution revealed striking microvascular, cellular and subcellular structures correlating with conventional histology. Individual tumor cells were identified. Applying the confocal probe to normal-appearing brain revealed a predominantly intravascular FNa distribution.

CONCLUSIONS:
Confocal endomicroscopy provided real-time in vivo histological information precisely related to the site of microscopic imaging. These data suggest that endomicroscopic FNa imaging offers the prospect of targeting biopsies to abnormal tissue, or conveniently evaluating tissue optically. With development this technology may increase diagnostic yield while decreasing the need for biopsies, and allow for more definitive tumor resection.

"Neuroanatomical Basis of Microsurgical Approaches to Lesions in Eloquent Brain Regions"

Mustafa K. Baskaya, MD.
Department of Neurological Surgery, University of Wisconsin-Madison

Proficiency in state of the art neurosurgical techniques requires microsurgical anatomical laboratory training. The most basic principle of medicine throughout the ages, "primum non nocere" (first, do no harm),

cannot be achieved in contemporary neurosurgery without having micro-neurosurgical skills and a proper knowledge of neuroanatomy and skull base anatomy. The brain is distinguished from the other vital organs of the human body by unique anatomical features. Sulci and gyri maximize the available cortical surface of the cerebrum in the limited volume of the skull. Most pathologies, whether neoplastic or vascular, are located beneath the cortical surface, sometimes as deep as ventricles or in the white matter surrounding the ventricles. Approaches to these deeply seated cerebral pathologies necessitate advanced techniques, such as the dissection of cisterns, which is only achievable by employing micro-neurosurgical skills or skull base approaches. These microsurgical techniques based on thorough neuroanatomical knowledge may result in better outcome in patients with complex lesions. In this presentation, we will demonstrate neuroanatomical basis of diverse microsurgical approaches to lesions in eloquent brain regions.

Forebrain and Spinal Cord Tumor Histology and Growth Are Determined By Unique Microenvironmental Responses to Paracrine Stimulation in PDGF Driven Models of Glioma

Ogden, Alfred, MD.
Department of Neurosurgery Columbia University

Introduction:
The histology and aggressiveness of gliomas are usually predictable based on their location within the CNS. Glioblastoma is the most common intrinsic tumor occurring in the cerebrum, but is extremely rare in the spinal cord where low grade astrocytomas and ependymomas predominate. The mechanisms underlying these anatomic predilections are not known, however, their study offers a new and untapped paradigm with which to study glioma pathobiology.

Methods:
Injection of PDGF-B expressing retrovirus into the subcortical white matter of adult rats induces the rapid formation of brain tumors with histological features of GBM. In contrast, when the same retrovirus is injected into the spinal cord of adult rats the resulting tumors are more indolent and display a unique histology characterized by nests of tumor cells separated by a dense vascular network without areas of necrosis. To examine if these differences were intrinsic to the cell of origin or due to the effects of the microenvironment, cells were isolated from brain and cord tumors and transplanted into the forebrain and spinal cords of naïve rats.

Results:
Tumors generated from these transplants were analyzed with respect to morphology, marker expression, and PDGFRα and PDGFRβ expression. Regardless of the tissue of origin, tumor phenotypes were consistently and reliably predicted by the tissue into which they were transplanted, not the tissue of origin. Immunohistochemical analysis demonstrated that forebrain tumors were dominated by uninfected PDGFRα+, GFP- recruited glial progenitors, whereas spinal cord tumors showed less recruitment of progenitors and a greater expansion of PDGFRβ+, GFP- vascular cells. A significant difference was found between these populations ($P = 0.0095$) when analyzing cell ratios from tumors grouped according to the recipient environment but not the tissue of origin.

Discussion/Conclusion:
These results indicate that the microenvironment rather the cell of origin is the primary determinant of glioma histology within the model, and that this response is regulated by a variable, tissue-specific expansion of recruited progenitor and vascular cells.

Gliosarcomas: management and outcome. A retrospective study.

Varsos, Vassilis, MD.
Department of Neurosurgery, Red Cross Hospital, Athens, Greece

Introduction:
Gliosarcoma is a rare tumour which displays clearly identifiable biphasic glial and metaplastic mesenchymal components. Characteristics that differentiate it from glioblastoma is temporal lobe predilection, intraoperative characteristics similar to meningioma, potential for extracranial metastasis and lower mutation prevalence rate of epidermal growth factor receptor (EGFR). We retrospectively reviewed data of eleven patients with confirmed diagnosed gliosarcoma between 2007-2013.

Material-Methods: The median age of the patients (6 male, 5 female) was 59 years old. Presenting symptoms were compatible with an expanding intracranial mass. The location was frontal, temporal and parieto-occipital. Magnetic Resonance Imaging findings denoted masses having heterogeneous enhancement and sharply demarcated or irregular borders. All patients underwent surgery.

Results: The histological diagnosis was confirmed by the expression of reticulin in the sarcomatosis site and GFAP (glial fibrillary acidic protein) in the glial tumour

site. All patients received the currently recommended therapy for glioblastoma of fractionated focal external beam radiotherapy with concurrent and adjuvant temozolomide. Recurrences were seen in the follow-up exams between 5–11 months and 3 patients underwent repeat surgery at the time of disease progression. The median survival from the time of diagnosis was nine months.

Discussion: Gliosarcomas represent a challenging tumour due to its rarity and poor prognosis. Neoplastic mesenchymal appearance and reticular formation should clearly be determined for histopathological diagnosis. A multidisciplinary approach (surgery, radiation therapy and chemotherapy) seems to be associated with slightly more prolonged survival times.

Osmotically active macromolecules are cleared through blood brain barrier: A pharmacological target for hydrocephalus?

Krishnamurthy, Satish MD.
Satish Krishnamurthy[1] MD MCh; Jie Li[1] MD, Lonni Schultz[2] PhD; Thomas M. Duncan[3] PhD; Kenneth Jenrow[4] PhD*

[1.]Department of Neurosurgery, SUNY Upstate Medical University
[2.]Department of Biostatistics and Research Epidemiology, Henry Ford Hospital
[3.]Department of Biochemistry&Molecular Biology, SUNY Upstate Medical University
[4.]Department of Neurosurgery, Henry Ford Hospital

Introduction:
Hydrocephalus is a central nervous system (CNS) disorder that manifests as an abnormal accumulation of cerebrospinal fluid (CSF) in the cerebral ventricles. Hydrocephalus can be experimentally induced by producing a sustained increase in CSF osmolarity1,2,3. Further, the severity of hydrocephalus is proportional to the increases in the osmotic load in the ventricles2. Other investigators have also confirmed the effect of osmotic gradients in the development of hydrocephalus 4,5,6. These results suggest that water transport into the ventricles is secondary to the osmotic load or the amount of macromolecules in the ventricles. We have previously shown that intraventricularly injected dextran is rapidly concentrated in the perivascular space surrounding microvessels throughout the brain. To explore how the brain clears the macromolecules in CSF for maintaining its osmotic gradient, we investigated the kinetics of distribution and clearance of fluorescently-labeled 10KD dextran (FITC-D) from CSF in the normal rat brain.

Methods:
Sprague-Dawley rats were used in this study. Using aseptic techniques, all rats received one time CSF injection at 1µl/s of total 15µl through cisterna magna (CM) with either FITC-D solution (1ug/ul) in group I (n=7) or sterile saline (control) in group II (n=7). Blood and urine samples were collected prior to injection, and every 30 minutes for 4 hours after injection. Both serum and urine samples were examined by spectrophotometric analysis for tracing the FITC-D particles.
Statistical analysis:
Statistical analysis was done by using nonparametric tests (Wilcoxon two sample tests and signed rank tests). P-values between 0.01 and 0.05 were interpreted as significant whereas p-values less than 0.01 were considered highly significant.

Fig. 1

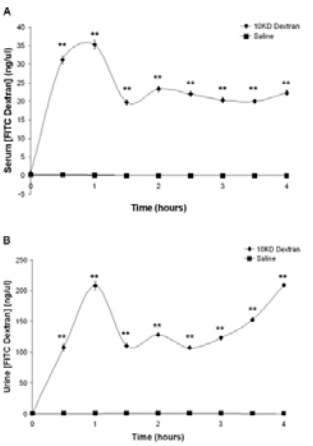


Fig. 2

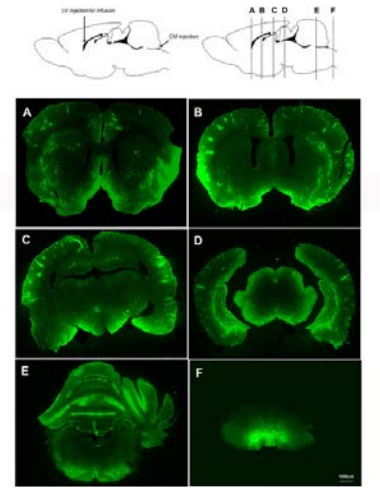


Fig. 3

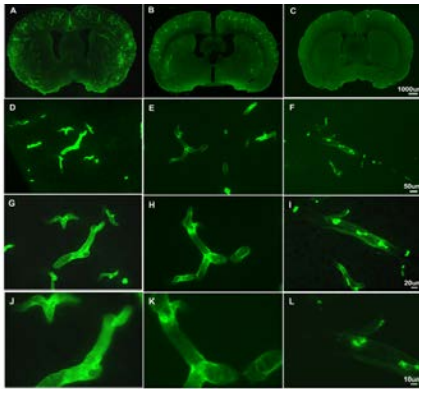
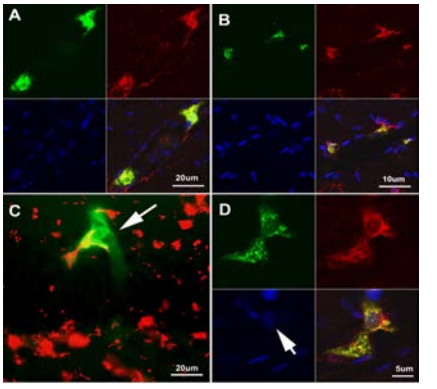


Fig. 4



Results:
The p-value for the comparisons of FITC-D vs control is 0.046 for urine and serum at both 30 and 60 minutes. For comparisons within the FITC-D injecting group, the p-value for pre vs 30 and 60 minutes was 0.015 for both urine and serum. For urine, 30 vs 60 minutes the p-value was 0.031. For serum, 30 vs 60 minutes the p-value was 0.234. FITC-D concentrations in blood serum reached a peak between 30 and 60 minutes postinjection, whereas peak concentration in urine occurred at 60 minutes postinjection. By 90 minutes postinjection, FITC-D concentrations had declined from their peak values but remained significantly elevated in both blood serum and urine for at least four hours post-injection (Fig1). CM injected FITC-D is present in perivascular space throughout the brain including the neocortex in a series of coronal sections (Fig2). Distribution of FITC-D in coronal sections of the rat brain at 1- 2- and 4-hours after CM injection show FITC-D distributed within perivascular space (Fig 3). Vesicular uptake of FITC-D by perivascular glia cells (Fig 4).

Conclusion:
Intraventricular dextran is cleared rapidly through blood brain barrier in normal rat to maintain its normal osmotic gradient. Dysregulation of CSF osmolarity resulting from a sustained influx of macromolecules in to CSF and/or compromise of clearance mechanisms may be the underlying cause of hydrocephalus. These processes may offer novel therapeutic targets for the treatment of clinical hydrocephalus. Future studies focused on targeting efflux transporters such as p-glycoprotein are currently underway.

F1: Graphs depicting the concentration of FITC-labeled 10KD dextran measured spectrophotometrcially in blood serum and urine as a function of time following injection in the cisterna magna. A. Dextran concentrations in blood serum reach a maximum between 30 and 60 minutes post-injection. B. Dextran concentrations in urine reach a maximum at 60 minutes post-injection. By 90 minutes postinjection, dextran concentrations in blood serum and urine have declined from their peak values but remain significantly elevated for at least four hours post-injection. (**, $P < 0.05$)

F2: A series of representative coronal sections obtained at the indicated positions (A through F) from the rat brain 2 hrs after acute injection of FITC-labeled 10 KD dextran into the cisterna magna (Group I). FITC-labeled dextran is present in perivascular space throughout the brain including the neocortex. All the images have the same scale bar (1000 μm).
F3: Distribution of FITC-labeled 10KD dextran in coronal sections of the rat brain at 1- 2- and 4-hours after cisterna magna injection (Group I). At 1-hour post-injection dextran is distributed throughout the brain including the neocortex (A, 10X) and is concentrated and homogeneously distributed within perivascular space (D, 100X; G, 200X; and J, 400X). At 2-hours post-injection dextran is noticeably reduced throughout the brain (B, 10X) and is concentrated near capillary junctions within perivascular space (E, 100X; H, 200X; and K, 400X). At 4-hours post-injection dextran is further reduced (C, 10X) and is seen primarily within perivascular cells undergoing what appears to be vesicular sequestration/transport (F, 100X; I, 200X; and L, 400X). Note that these cells are not visible at 1- or 2-hours post-injection.

F4: Distribution of FITC-labeled 10KD dextran (green) in specific cell types in the rat brain parenchyma. Where present, DAPI (blue), a general label of cell nuclei, was used as a counter stain. A. (400X) Dextran is observed within perivascular astrocytes labeled immunohistochemically with GFAP-Cy3 (red). B. (200X) Dextran is observed within a perivascular microglial cell labeled immunohistochemically with Iba-1-Cy3 (red). C. (400X) Dextran is observed within perivascular space surrounding a capillary, perhaps reflecting local exocytosis of labeled dextran (green) from the adjacent Iba-1-Cy3-labeled perivascular microglial cell (labeled red). Note: the yellow color (arrow) reflects colocalization of dextran (green) within the microglial cell (red). D. (600X) Dextran is observed undergoing vesicular sequestration/transport within an Iba-1-Cy3-labeled perivascular microglial cell (red). The vast majority of cells engaging in vesicular sequestration/transport of dextran are perivascular microglia.

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Long-term effects of rigid instrumentation and fusion at the craniovertebral junction in young children

Anderson, Richard, MD.
Benjamin Kennedy[1], Michael McDowell1, Todd Hankinson[2], Sean Lew[3], Andrew Jea[4], Daniel Couture[5], Jeff Leonard[6], Luis Rodriguez[7], Gerald Tuite[7], David Pincus[8], Douglas Brockmeyer[9], and Richard C. E. Anderson[1] on behalf of the Pediatric Craniocervical Society

[1]Columbia University, New York, NY; [2]University of Colorado, Denver, CO; [3]Children's Hospital of Wisconsin, Milwaukee, WI; 4Texas Children's Hospital, Houston, TX; [5]Wake Forest University, Winston-Salem, NC; [6]Nationwide Children's Hospital, Columbus, OH; [7]All Children's Hospital, St. Petersburg, FL; [8]University of Florida, Gainesville, FL; [9]University of Utah, SLC, UT

Introduction:
The long-term consequences of atlantoaxial and occipitocervical fusions in young children are unknown. We present a multi-institutional study to determine the long-term effects of these surgeries on the growth and alignment of the maturing spine.

Methods:
A multi-institutional retrospective chart review was conducted at nine participating centers from 1995-2010. Thirty-six patients 6 years old or younger (mean 3.4, range 1.5-6 years) who underwent OC or C1-2 rigid instrumentation and fusion with at least 3 years of clinical and radiographic follow-up were included. Preoperative, immediate postoperative, and most recent followup X-rays or CT scans were evaluated to assess changes in spinal growth and alignment.

Results:
All patients demonstrated fusion on follow-up imaging. At a mean follow-up of 57 months, there were no cases of new sagittal malalignment, evidence of subaxial instability, or unintended subaxial fusion. The lordotic curvature of the cervical spine increased from a mean of 11 degrees postoperatively to 23 degrees at follow-up. A mean of 18% of the vertical growth of the cervical spine occurred within the fusion segment.

Translaminar screws are safe and effective in lumbar fusion surgery:

Chin, Larry, MD.
Department of Neurosurgery, SUNY New York

Introduction:
Translaminar screws have biomechanical advantages over conventional pedicle screws because of their greater degree of cortical purchase resulting in greater pull-out strength. The approach also requires a less extensive spine exposure and therefore less disruption of paraspinous muscle attachments.

Materials and Methods:
I present a series of 14 patients who have undergone a lumbar or thoracolumbar midline fusion (MIDLF) using superolateral screw trajectory. Ten patients had a combination of spinal stenosis and/or disc herniation with mechanical back pain and four patients had unstable L1 burst fractures. Median follow-up is brief at this time averaging 4 months.

Results:
There were no instances of misplaced screws or nerve root injuries. One patient developed T11 screw pullout at 6 months but had patient compliance issues. The remainder of the patients maintained construct integrity and had improvement in their clinical condition. There were no neurological complications and there were no wound infections or breakdown.

Conclusion:
In this very preliminary experience, the translaminar screw approach appears safe and effective. Longer follow-up and greater case numbers will be needed to confirm this early experience.

Radiographic Predictors of Proximal Junctional Kyphosis after Long Segment Thoraco-Lumbar Fusion for Adult Spinal Deformity

Hoh, Daniel, MD.
Raul Vasquez-Castellanos, Reordan De Jesus, Dan Neal, R. Patrick Jacob, Daniel J. Hoh
Department of Neurosurgery, University of Florida, Gainesville

Introduction:
Proximal junctional kyphosis (PJK) is a frequent complication after long segment thoraco-lumbar fusion for adult spinal deformity (ASD) with potentially significant impact on clinical outcome. The reported incidence of PJK is wide-ranging, while the etiology

and risk factors of PJK remain poorly understood. The purpose of this study, therefore, was to determine the incidence and radiographic predictors for PJK occurrence after adult spinal deformity surgery at a single institution, neurosurgical department.

Methods:
We performed a retrospective analysis of consecutive adults (age ≥21 years) that underwent long segment thoraco-lumbar fusion (≥7 vertebrae) for ASD at a single institution, neurosurgical department between 2008-2013. Pre-operative and post-operative clinical and radiographic data were evaluated. Radiographic measurements included thoracic kyphosis (TK), lumbar lordosis (LL), sagittal vertical axis (SVA), pelvic incidence (PI), pelvic tilt (PT), and sacral slope (SS).

Results:
Sixty-five patients met inclusion criteria with a mean age of 65 years. Average follow up was 1.2 years. Thirty-eight (59%) patients developed PJK at last follow up, with four (11%) requiring additional surgery to treat PJK. Older age at time of surgery and greater pre-operative thoracic kyphosis predicted post-operative PJK occurrence ($p<0.0001$ and $p<0.042$, respectively). Not surprisingly, fracture at the proximal level of the construct was also associated with PJK ($p<.0001$). Radiographic parameters of ideal deformity correction such as SVA <50 mm, PT <20°, and PT-LL <±10° were not associated with lower incidence of PJK.

Conclusion:
Radiographic PJK occurs commonly after long segment thoracolumbar surgery for adult spinal deformity. Older age and greater pre-operative thoracic kyphosis are associated with higher risk of PJK. Incidence of revision surgery to treat clinically significant PJK, however, remains low.

A Stereotactic Atlas of the Human Lumbar and Sacral Spinal Cor

Robert G. Grossman, MD.
Hanna Tang, MD.
Department of Neurosurgery, Houston Methodist Hospital

A stereotactic atlas of the human lumbar and sacral spinal cord was created by using high-resolution microscopy and digital imaging of human cord tissue, with the clinical goal of guiding cellular transplantation and guiding placement of epidural stimulating electrodes for restoring movement in individuals who have sustained spinal cord injury. The present atlas of the lumbar and sacral cord is the first stage of creating an atlas of the entire spinal cord.

Under a Methodist Hospital IRB approved protocol, the spinal cord was removed in adult autopsies and placed in 4% paraformaldehyde for 48 hours. The location of exit of the ventral and dorsal roots of each segment was measured with respect to the caudal end of the conus and photographed. The cord was then cut into blocks approximately 10mm in length, corresponding to the mid-point of the exit of the lumbar and sacral ventral roots of each cord segment. The blocks were placed in sucrose solutions. The caudal surface of each segment was marked with red dye over the right dorsal horn for orientation during sectioning and mounting on slides. Frozen sections were cut at 50 microns. Methods were developed for obtaining myelin (luxol fast blue) and neuronal (Nissl) staining and for immunohistology for MAP2 and for choline acetyltransferase, calbindin, parvalbumin and gephyrin to identify excitatory and inhibitory neurons. Good preservation of cellular morphology and immunoreactivity was obtained in cords that were removed at autopsy performed between 6 and 12 hours after death.

The atlas is based upon study of 20 spinal cords. The cytoarchitecture and stereotactic coordinates are illustrated with 18 Nissl stained cross-sections from cord segments L1-S4. The illustrative sections were cut from one cord, sectioning each cord segment from caudal to rostral. The sections in the atlas are approximately 5mm apart. The stereotactic coordinate system is based upon the anatomical features of the cord visible to the surgeon at operation. The zero point for depth coordinates is the dorsum of the cord at the midline raphe. The zero point for right and left laterality is the midline raphe. The positions of the ventral spinal artery and the dorsal and ventral roots are also shown.

Inserts facing the cross-sectional figures show the location of presumed inhibitory neurons; most of these were immunoreactive for gephyrin. They tended to be clustered around the margins of motorneuron groups of the ventral horn. Cross-sections of the cord stained for myelin and MAP2 are included.

A figure showing correlation between vertebral body levels and spinal cord motorneuron segmental levels is included to aid in surgical planning. The lumbosacral cord from segment L1 to the tip of the conus extends an average distance of 8 cm in the cords that we have measured and sectioned.
The atlas will be made available by posting on the web and by publication as a monograph.

Optimization of a Novel Cell Therapy for Degenerative Disc Disease Using a Porcine Model

Kevin, Foley, MD.
L I Silverman; G Dulatova; K Gupta; A Howard; S Chintalacharuvu; K Foley
University of Tennessee, Memphis

A clinically successful approach to treating the pain associated with degenerative disc disease (DDD) is to supply the disc with a new cell population that modulates cytokines and extracellular matrix. Our group is developing an injectable cell therapy with human disc-derived progenitor cells within a hyaluronic acid scaffold carrier. We have shown safety and efficacy of this treatment in numerous rabbit studies and a pilot pig study. Here, we utilize a pig model of DDD to test the effect of cell and scaffold concentration on efficacy, and assess toxicological parameters of safety. Methods: Using a validated model of DDD, annular puncture was performed in 8 Gottingen pigs (3 discs/pig). After 1 month, 0, 10,000 cells, 100,000 cells, or 1,000,000 cells in either 0.5% HA or 1% HA were injected into each disc (n=3/condition, 150µl/injection, injured control maintained as well). Animals were sacrificed after 1 additional month, and MRI and histology was performed. Body weight, blood (hematology and clinical chemistry), clinical behavior and x-ray measurements were taken throughout the study. Results: Body weight, clinical chemistry, hematology and clinical observations were normal for the duration of the study. T2 weighted MRI showed a decrease in nucleus pulposus size and intensity with injury, with no further degradation after cell treatment and no abnormalities noted. The percent change in disc height from 4 to 8 weeks increased for 100,000 cells in 1% HA compared to control ($p < 0.05$, 1-way ANOVA), but decreased for the other cell concentrations, suggesting dose-dependent efficacy in the range explored (100-fold). There was no difference between HA concentrations ($p < 0.05$, 2-way ANOVA). In conclusion, this study helps identify the optimal formulation of a treatment for degenerative disc disease in a large animal model utilizing key parameters of safety and efficacy that will translate to human clinical trials.

Neuronavigation accuracy in epilepsy surgery with surface registration versus bone fiducial registration

Alexander M. Papanastassiou, MD.
University of Texas, San Antonio

Introduction:
Intraoperative image guidance relies upon accurate image-to-patient registration. Surface-based registration accuracy may be limited by registration algorithms, the deformability of soft tissues, and other factors. In staged epilepsy surgeries, screws implanted in bone may be used as fixed fiducials, potentially improving registration accuracy and allowing testing of registration accuracy.

Methods:
Accuracy of bone fiducial and surface registration was tested in cranial models and patients. Six cranial models were implanted with twelve 4 mm screws around typical craniotomies and CT scans were obtained to determine fiducial location. Surface registration or fiducial registration with 4, 5, 6, or 7 screws was performed. Remaining screws not used as fiducials served as landmarks to measure registration error, determined as navigated location vs. expected location on CT.

In six staged epilepsy procedures, twelve 4 mm screws were implanted around the craniotomy margin. At the second surgery, surface-matching registration was performed, the wound was reopened, and the navigated locations of the twelve screws were acquired. The surface registration error was calculated as navigated location versus expected location. Next, six screws were registered as fiducials and registration error was measured using the remaining six screws as landmarks. Additionally, electrode locations were acquired and compared with their location on CT.

Results:
In models, the registration error with bone fiducials was less than with surface registration (0.85±0.48 mm vs. 3.27±1.49 mm). No difference was found using 4, 5, 6, or 7 screws. Intraoperative registration error with screw fiducials was less than with surface registration (0.89±.66 mm vs. 4.52±4.74mm). The mean error of navigated electrode location after bone fiducial registration compared with location on CT was 2.97mm (SD 1.61).

Conclusion:
Bone fiducial registration is more accurate than surface registration in cranial models and during surgery. Bone fiducials allow accurate localization of intracranial electrode locations, which may be particulary important for a revision of electrodes, second intracranial electrode study, or implantation of neurostimulation electrodes.

Roberts, David, MD.
X Fan, S Ji, A Hartov, KD Paulsen KD Paulsen
Geisel School of Medicine at Dartmouth and Dartmouth-Hitchcock Medical Center, Lebanon, NH

Introduction:
This study describes the implementation of a stereoptic-based imaging system and in a series of tumor and epilepsy surgeries explores the hypothesis that intraoperative stereotactic co-registration of three-dimensional contour optical imaging of the surgical field with conventional radiologic imaging modalities will enable localization guidance (cortical, electrode, mapping and resection), updated registration, and archival documentation.

Methods:
An upgraded stereovision system compromised of two 1024 X 768 color CCD cameras attached to an operating microscope at a binocular port and employing an optical flow algorithm provides 3-D coordinate localization of each pixel at a frame rate of 15/sec. Accuracy of the current implementation of this system was assessed during surgery by feature localization relative to a tracked stylus. Surgical field localization with respect to preoperative MRI, utility in functional mapping, displacement mapping of cortical features and of implanted electrodes, and intraoperatively updated registration were performed.

Results:
Application in 150 epilepsy and tumor cases superposed high resolution, surface-contour color images on MRI 3-D reconstructions, and in 32 epilepsy cases these were used for intraoperative planning, localization, guidance, and documentation. Accuracy assessment by feature localization relative to a tracked stylus was 1.0±0.5 mm. Displacement fields enabled intraoperative updated registration from initial errors of 4.0 - 9.8 mm. In eight patients undergoing two-stage procedures, the mean average displacement of subdural electrodes at second surgery was 5.2±1.8mm, with a range of 0.6 to 12.9mm.

Conclusions:
A stereovision-based imaging system integrated into the operating microscope can be efficiently incorporated into the work-flow of the surgical procedure. Intracranial electrode and cortical mapping localization, updated correlation with MRI, and documentation through stereotactically-registered 3-D optical images were demonstrated to be feasible and useful.

Aggressive surgical resection is the treatment of choice for symptomatic aggressive vertebral hemangiomas.

Choi, David, MA. FRCS. PhD
The National Hospital for Neurology and Neurosurgery, Queen Square, London UK.

Introduction:
Asymptomatic vertebral body hemangiomas are very common, occurring in 10-12% of people at autopsy. Rarely they can cause pain or pathological fracture. However, an unusual subgroup of hemangiomas can be expansile and cause spinal cord compression, and are called aggressive, atypical, or expansile hemangiomas.

Methods:
Retrospective case review of 10 patients who had surgical treatment for aggressive thoracic vertebral hemangiomas.

Results:
Age range of patients was 22 - 66 years. Six patients underwent complete spondylectomy ("Tomita technique"), 2 patients underwent complete spondylectomy by 2 stage posterior approach and thoracotomy, 1 patient had a wedge corpectomy, and 1 patient underwent laminectomy. There was no tumour recurrence in the 9 patients who had complete resection (follow-up range 2-101 months, mean 45 months). Two patients had transient neurological deficits, but normal function by 3 months after surgery. 1 patient had a haemothorax requiring surgical drainage. There were no mortalities.

Conclusions:
The complete resection of aggressive vertebral haemangiomas by en bloc spondylectomy is possible with acceptable morbidity and good recurrence free survival.

Gunshot wounds to the spine: the role of decompressive laminectomy

Hildo Azevedo-Filho MD, PhD, MSc, FRCS (SN), FAANS
Professor of Neurological Surgery
Hospital da Restauração, Recife, BRAZIL

Gunshot wounds to the spine are a devastating calamity. Specific literature is scarce, as large series are seldom encountered. In the absence of extensive data, it is difficult to evaluate the complications and the effect of several forms of treatment.
This review was based on the analysis of 246 patients with gunshot wounds to the spine admitted to the

Department of Neurological Surgery of the Hospital da Restauração, Recife, Brazil between 1981 – 1998 and another 127 patients admitted between 2005 – 2008. The pre and post treatment neurologic condition was judged according to the Frankel/ASIA/IMSOP classification. All patients underwent X-Rays investigation and about 50% underwent computed tomography.
Decompressive laminectomies were associated with a higher level of complications and did not improve patients conditions.
Therefore, as until now we do not have a prospective multicenter study, I no longer recommend decompressive procedures for this type of pathology.

High cervical diffusion tensor imaging (hcDTI) metrics, rostral to the injury site

Shekar N Kurpad MD. Ph.D.
Professor of Neurosurgery
Director, Spinal Cord Injury Center
Medical College of Wisconsin

Objectives
High cervical diffusion tensor imaging (hcDTI) metrics, rostral to the injury site, have been shown to be a potential biomarker in patients with chronic spinal cord injury (SCI). However, this approach has not been evaluated early after SCI. We characterized hcDTI metrics in patients with blunt acute and subacute cervical spinal cord injury (SCI).

Methods
Patients with traumatic cervical cord injury underwent pre-surgical DTI at a mean duration of 3.5±0.9 days days post-injury. hcDTI metrics of the whole cord and individual white matter funiculi were calculated at the C1-C2 level, which was remote from the injury site. Whole cord DTI metrics were also measured within intramedullary T2W hyperintensities in all patients (t2wDTI). DTI metrics in patients were compared to corresponding metrics in eleven controls of similar ages.

Results
No patient had intramedullary T2W hyperintensities that extended above the C2-C3 disc space. hcDTI showed significant decrease in FA and increase in tADC in SCI patients. Identical changes were observed in the individual white matter funiculi at the C1-C2 level. t2wDTI metrics also showed a significant decrease in FA and increase in tADC. hcDTI metrics particularly MD, lADC and tADC showed a significant positive association with t2wDTI metrics ($p<0.05$).

Conclusion
hcDTI is in acute/subacute cervical SCI is sensitive to rostral neural injury and is associated with similar changes in DTI metrics at the injury site. hcDTI can potentially be used to investigate longitudinal changes in DTI metrics after SCI and is a biomarker for both acute and chronic spinal cord injury.

Shower of Microemboli following skull base fracture

Bristol, Ruth, MD.[1]
Felipe Albuquerque MD[2]*, John Condie MD*[1]
[1]*Barrow Neurological Institute at Phoenix Children's Hospital, Phoenix, AZ ;* [2]*Barrow Neurological Institute, Phoenix, AZ.*

Transcranial Doppler ultrasonography (TCD) is used in many settings, including carotid stenting, cardiac angiography, orthopedic surgery, and traumatic brain injury and hemorrhage. The ability to detect microembolic signals has been used as a predictor for cerebral ischemia, decision making for the use of anti-platelet agents, and indicators of cerebral remodeling in atherosclerotic disease. Although TCDs are used for evaluation of cerebral blood flow, the detection of microemboli in trauma has not been previously reported. In this case, microemboli were detected in a patient with a traumatic vascular injury of the skull base..

A 14-year-old boy suffered a fall from a horse during which he struck his face on a wooden fence. Initial CT of the head revealed multiple skull base and facial fractures, inlcluding a fracture through the left carotid canal. CT angiography revealed a pseudoaneurysm of the medial carotid wall (Figure 1). Transcranial Doppler ultrasonography revealed 4 microemboli in a 5 minute period on the day of admission. Twelve hours later, the number of microemboli had increased to 77 over 5 minutes (Figure 2). The patient underwent placement of a flow diverting stent at the level of the aneurysm that day (Figures 3 and 4). Two days later, microemboli were not detected during a 5 minute recording. Following stenting, the patient developed a carotid-cavernous fistula, which required two sessions of trans-venous embolization to achieve thrombosis and radiographic cure (Figure 5). It is presumed that the stent restored laminar flow, thus eliminating the source of microemboli.

Ttranscranial Doppler ultrasonography is a sensitive tool for the detection of vascular injuries that impact blood flow in head trauma. As there is controversy over the true incidence of vascular injury for head

trauma, TCDs with microemboli detection add another diagnostic tool to guide further work up and treatment. It has advantage of being a bedside study that does not expose the patient to radiation. We advocate a baseline TCD study on admission with follow up 24 hours later for any patient with a fracture extending across the skull base.

Fig. 1

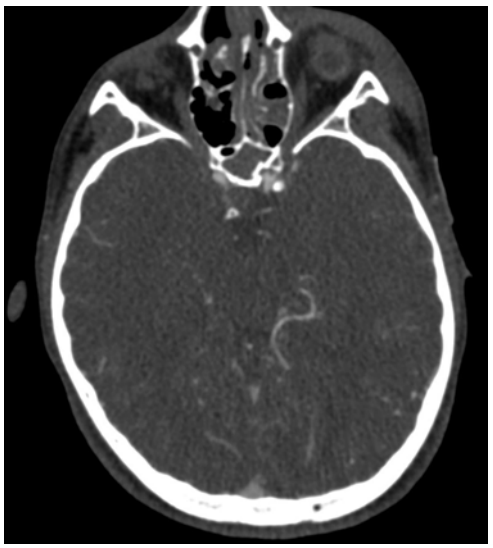


Fig. 2

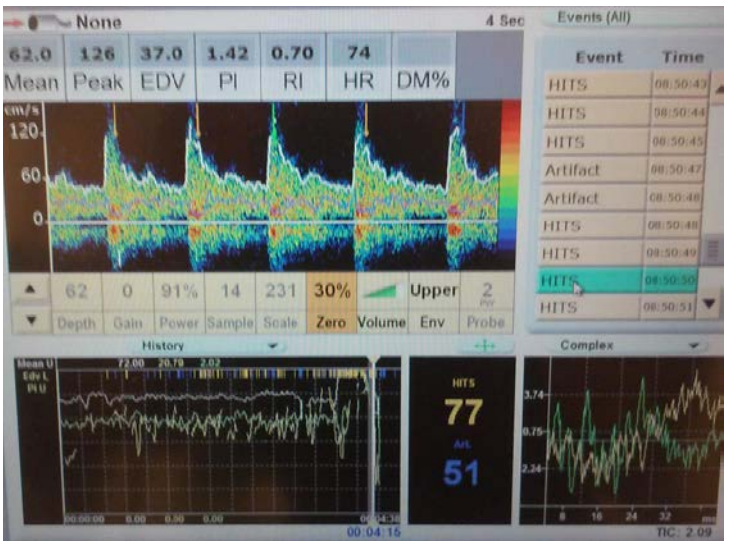
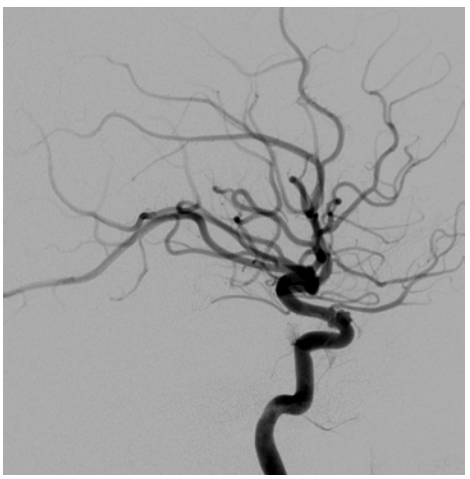


Fig. 3



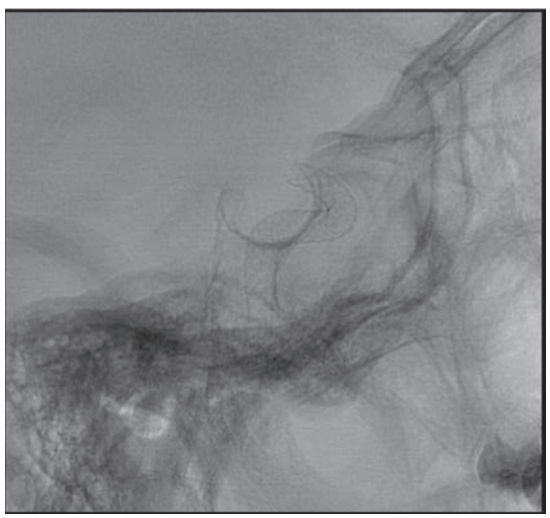


Fig. 4

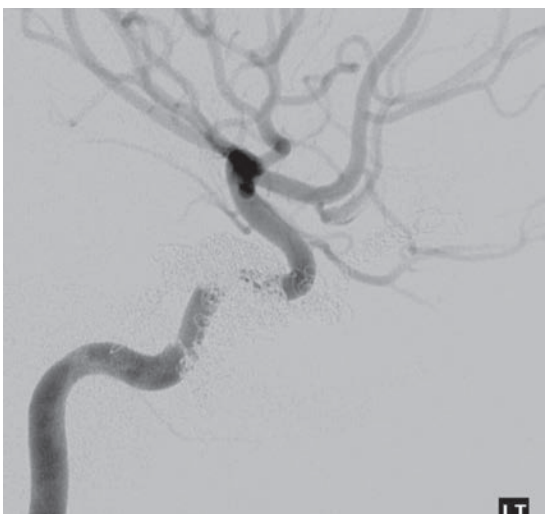


Fig. 5

Myeloperoxidase as a Screening Biomarker for Human Cerebral Aneurysms

Hasan, David, MD.
Yi Chu, William M. Nauseef, Gary L. Pierce, Guangjie Cheng, Lauren Wegman-Points, Ricardo A. Pena Silva, Donald D. Heistad,*
University of Iowa Carver College of Medicine, Iowa City, IA, USA and University of Alabama School of Medicine, Birmingham, AL, USA.*

Abstract:
The neutrophil granule protein myeloperoxidase (MPO) reacts with H2O2 to oxidize chloride, thereby generating hypochlorous acid (HOCl), a highly reactive product. Circulating levels of MPO are increased in many inflammatory diseases, and have been linked to oxidative stress and elevated risk for vascular disease in humans. We hypothesized that MPO is increased locally in human intracranial aneurysms. Blood, both from the lumen of the aneurysm and femoral artery, and tissue, both from the aneurysm wall and from a superficial temporal artery, were sampled from seventeen patients with intracranial aneurysms who underwent microsurgical clipping. Plasma concentrations of MPO (ELISA) were 3-fold higher in aneurysm (100±15 ng/ml) (mean±SE) than in femoral blood (33±10; p=0.0007). Plasma concentrations of vascular peroxidase 1 (VPO1), a homolog of MPO that is expressed in endothelial cells, were not increased in aneurysm (384±51 µg/ml) compared to femoral blood (513±65; p=0.12). mRNA expression (RT-qPCR) was similar in leukocytes recovered from aneurysmal blood (2005±377 copies/50 ng RNA for MPO and 342±98 for VPO1) and femoral blood (2129±313 for MPO and 381±61 for VPO1; p=0.5 and 0.73, respectively). There were significantly more MPO-positive cells (immunohistochemistry) in aneurysm tissue (69±8 positive cells/field, 32%±3% of total cells) than superficial temporal artery (6±3 positive cells/field, 2%±1%; p<0.001). To test the role of MPO in aneurysm formation, we utilized a mouse model of intracranial aneurysms in which aneurysmal rupture (i.e., aneurysmal subarachnoid hemorrhage) occurs spontaneously and causes neurological symptoms. Aneurysms were induced in 12 MPO knockout mice and 12 control. Using this model, mice deficient in MPO had significantly lower incidence of aneurysms (50%) than the wild-type control (>90%). The occurrence of subsequent subarachnoid hemorrhage was also lower in MPO deficient mice (~10%) than the wild-type control (~90%). Cerebral vessels were harvested at the end of the in vivo study, and mRNA levels were quantified using RT-qPCR. As expected, MPO expression was absent in MPO-deficient mice. Neutrophil elastase, a neutrophil marker, was 10-fold lower in MPO-deficient mice than control mice. TNFα, CXCL1, MMP3 and 13, and CD68 were significantly lower in MPO-deficient mice, suggesting reduced inflammation and macrophages in MPO-deficient mice. Also we compared MPO from patients with cerebral aneurysm and control patients without aneurysms. MPO was significantly hinger in patient with intracranial aneurysms (p <0.05).
These findings suggest that MPO play a critical role in aneurysm formation and progression to rupture and this biomarker could be used as a screening tool for detecting cerebral aneurysms in human. Larger study is needed to confirm these findings.

Bypassing the Emergency Room in the treatment of acute stroke

Liebman, Kenneth MD.
Stroke & Cerebrovascular Center of New Jersey

Background:
Emergency medical service pre-notification to hospitals regarding the arrival of stroke patients is recommended to facilitate the work-up once the patient arrives. Most hospitals have the patient enter the emergency room prior to obtaining a head CT.

Objective:
At Capital Health, pre-hospital stroke alert patients are delivered directly to CT and met by a neurological emergency team. The goal of bypassing the emergency room is to reduce the time to treatment.

Methods:
This is a prospective study evaluating 1) door-to-CT and door-to-needle time in acute stroke patients who arrive as pre-hospital stroke alerts and 2) the accuracy of EMS assessment.

Results:
Between July 2012 and July 2013, 141 pre-hospital stroke alerts were called to our emergency department and stable enough to bypass the ED and go directly to CT. EMS assessment of stroke was accurate 66% of the time and the diagnosis was neurological 89% of the time. The average time between patient arrival and acquisition of CT imaging was 11.8 minutes. Twenty-six of the 141 patients (18%) received IV tPA. The median time from arrival to IV tPA bolus was 44 minutes.

Conclusions:
Trained EMS are able to correctly identify patients who are suffering from neurological/neurosurgical emergencies and deliver patients to our comprehensive stroke center in a timely fashion after pre-notification.

The Pre-hospital stroke alert protocol bypasses the ED, allowing the patient to be met in CT by the neurological ED team which has proven to decrease door-to-CT and door-to-needle times from our historical means.

Intraarterial (IA) Therapy of Cerebral Vasospasm: Comparison of Single Agent vs Multiple Agent Infusion

Kadir Erkmen MD.
Aditya Sanzgiri, Mayurika Pise, Peng Roc Chen
Univ of TX Medical School of Medicine at Houston, Houston, TX

Background:
Cerebral vasospasm remains a major cause of morbidity and mortality in patients with subarachnoid hemorrhage. Vasospasm treatment typically includes IA infusion of vasodilators; however the optimal agent/s have not been elucidated. National surveys suggest that IA treatment algorithms vary between centers and commonly involve use of a single agent. We hypothesize that IA infusion of a cocktail of multiple vasodilators is more efficacious than single agent treatment.

Methods:
A prospective case series of consecutive patients with cerebral vasospasm (Group 2, N=50 patients, 106 vessels) treated between 2010-13 with IA infusion of a specific cocktail of multiple agents (nitroglycerin, verapamil and nicardipine) at a tertiary center, were compared to a historic control group (Group 1, N=54 patients, 116 vessels) at the same center between 2008-10 treated with a single agent (nicardipine or verapamil). Patient demographics, age, and modified Rankin score (mRS) at discharge and 3 months were collected in the cerebrovascular database. Arterial luminal diameters were measured on cerebral angiograms both pre-infusion (PrID) and post-infusion (PoID). The Improvement Ratio (IR) = (PoID - PrID/ PrID) x 100 was calculated and statistically compared between groups using the T test.

Results:
Group 2 demonstrated statistically significant improvement IR 45.8% (SD 36.6) than Group 1 IR 10.9% (SD 12.0), P<0.001. Multiple agent infusion resulted in an average of 34.9% greater vessel diameter improvement than single agent therapy. Comparison of IR between different single agents within group 1 (nicardipine and verapamil) demonstrated no difference in vessel diameter change. Age of the patient had no effect on efficacy in either group. Patient outcomes measured by mRS were similar at discharge and at 3 months follow-up.
Discussion: Treatment of cerebral vasospasm with an IA cocktail of nitroglycerine, verapamil, and nicardipine provides significantly better angiographic improvement of vasospasm than single agent therapy. This effect appears independent of patient age. Outcomes measured by mRS at discharge and 3 months were not significantly different, however will be examined in an ongoing prospective multi-center trial.

Balloon Remodeling of Complex Anterior Communicating Artery Aneurysms: Technical Considerations and Complications

Albuquerque, Felipe, *MD.*
MD; Karam Moon, MD; Andrew F Ducruet, MD; R. Webster Crowley, MD; Cameron G. McDougall, MD
Barrow Nerological Institute, Phoenix, AZ

Introduction:
Reports of the limitations and feasibility of balloon remodeling for treatment of complex anterior communicating artery (ACoA) aneurysms are scarce.

Methods:
Ninety-nine patients were treated with balloon-assisted coil embolization for ACoA aneurysms between 8/2004 and 10/2012. Records were reviewed for aneurysm characteristics, balloon trajectory (vessel and side), bilateral access, treatment-related complications, and aneurysm recurrence determined by magnetic resonance angiography (MRA). Morphological outcomes following treatment were categorized by Raymond Class I, II, or III.

Results:
Fifty-three (53.5%) aneurysms were unruptured and 46 (46.4%) were ruptured. Aneurysmal occlusion (Raymond I or II) was achieved in 89 (89.9%) patients. Three (3.0%) were incompletely embolized and treatment was aborted in six (6.1%). Balloon trajectories were from the A1 to either the ipsilateral or contralateral A2. In seventeen (17.2%) cases, bilateral A1 access was utilized to achieve balloon protection of the contralateral A2. In four (4.0%) cases, balloon remodeling was aborted due to technical difficulty. There were 15 (15.2%) treatment-related complications. Five (5.1%) were intraoperative ruptures, one resulting in a neurological deficit and another in death. All other complications were clinically silent, producing a permanent complication rate of 2.0%. Mean radiographic follow-up was 2.5 years, and six (6.1%) patients were retreated for recurrence or known remnant.

Conclusions:
Balloon remodeling should be considered for broad-based, complex ACoA aneurysms. This technique provides a high-rate of aneurysm occlusion with an acceptable complication profile, and avoids the need for dual antiplatelet therapy. Balloon trajectory will depend on aneurysm morphology and bilateral access may be useful in select cases.

Multidisciplinary management of unruptured anterior circulation aneurysms by open minicraniotomy or endovascular therapy: Analysis of costs and outcomes.

Michael Tymianski MD.
Christian Zweifel, Raphael Hillel Sacho, Ivan Radovanovic
Division of Neurosurgery and Neuroradiology, Toronto Western Hospital, University Health Network and University of Toronto, Toronto, Ontario, Canada

Introduction:
Advances in both endovascular and surgical treatment of intracranial aneurysms have reshaped their clinical management. We thus evaluated clinical and radiological outcomes and costs associated with a multidisciplinary strategy relegating patients with unruptured anterior circulation aneurysms to microsurgery by minicraniotomy or by modern endovascular procedures.

Methods:
From 2007-2012, 209 consecutive patients with unruptured, non-giant, saccular, anterior circulation aneurysms were treated with minicraniotomy and clipping or endovascular techniques (102 and 107 patients, respectively). Allocation to either treatment was by an interdisciplinary conference in which the right of first refusal was given to the endovascular team. Thus, surgical patients were those deemed unsuitable for endovascular therapy or those deemed equally suitable to either technique when patients preferred to undergo surgery. We evaluated patient demographics, aneurysm characteristics, obliteration rates, complications, clinical outcomes, length of stay and treatment costs.

Results:
There were no differences in baseline demographics or mean length of stay. Mean aneurysm sizes were 6.8 mm in the minicraniotomy and 7.9 mm in the endovascular group ($p=0.011$). More paraophtalmic and fewer MCA aneurysms were treated endovascularly (54 vs 6, $p<0.0001$ and 4 vs 60, $p<0.0001$, respectively). Surgery resulted in shorter anesthesia time (197.7 vs. 149.3 min, $p<0.0001$), higher rates of complete aneurysm obliteration (94.57% vs. 66.67%, $p<0.0001$), and lower overall hospital costs ($8,287 CAD versus $17,732 CAD, $p < 0.0001$) as compared with endovascular treatment. There were no statistical differences in adverse clinical outcomes (mRS 3-6), but the study was underpowered to reveal such differences. In the endovascular cohort, two patients died due to treatment (mRS = 6) and one suffered a severe stroke (mRS = 5 at 6 months). There were no treatment related deaths in the surgical cohort, but one patient had a mRS of 3 after 6 months due to temporal lobe epilepsy and memory problems. Collectively, our collective approach to treating the entire patient cohort resulted in adverse outcomes in 1.9% of patients.

Conclusion:
A multi-disciplinary approach to treating unruptured, non-giant, saccular aneurysms of the anterior circulation results in a low rate of adverse clinical outcomes. Clipping by minicraniotomy for those that are either unsuitable for endovascular therapy or equally suitable for endovascular and surgical treatment is as safe, results in high obliteration rates and is less costly than endovascular treatment of aneurysms deemed suitable for endovascular treatment.

Evaluation of Time to aneurysm treatment following subarachnoid hemorrhage: comparison of patients treated with clipping versus coiling

Mack, William MD.
Keck School of Medicine of USC, Los Angeles, CA

Introduction:
Time to treatment for aneurysmal subarachnoid hemorrhage (aSAH), as well as treatment in a teaching institution, has been correlated with patient outcome. We hypothesized that teaching institutions may provide decreased time to treatment in both open aneurysm clipping and endovascular aneurysm coiling cohorts when evaluating a national inpatient database.

Methods:
Patients with aSAH and treated with aneurysm clipping or coiling between 2002 and 2010 in the Nationwide Inpatient Sample (NIS) were analyzed. Time to aneurysm treatment was dichotomized to more than three days or to three or fewer days. Time to aneurysm treatment was evaluated via multivariable logistic regression modeling,

controlling for patient and hospital covariates. Identified predictors for prolonged time to procedure were compared between the clipping and coiling populations.

Results:
Between 2002 and 2010, there were 90,684 aSAH admissions with subsequent clipping and coiling procedures. Surprisingly, while teaching hospitals were associated with decreased delay to clipping procedures (OR=0.61[0.46,0.82], p=0.001), this was not seen with coiling procedures (p=0.61). Younger age (less than 65) was also associated with decreased time to clipping (p=0.004, OR=0.50,[0.32,0.80], but not associated with time to coiling (p=0.35).

Conclusion:
Patients treated at a teaching hospital were more likely to receive aneurysm clipping with less delay. However, teaching hospital status did not affect time to coiling.

Efficacy of facial nerve-sparing approach in patients with cerebellopontine angle meningiomas.

Sisti, Michael MD.
Moshe Praver, Randy S. D'Amico, Matei A. Banu, Hani R. Malone, Steven R. Isaacson
Columbia University

Introduction:
Meningiomas arising in the cerebellopontine angle (CPA) are challenging surgical lesions. This is mainly due to their proximity to critical neurovascular structures located within the region. Studies have shown that Gamma Knife surgery (GKS) provides acceptable rates of tumor control. However, we hypothesize that in larger non GKS tumors that to preserve neurologic function a strategy of safe subtotal resection combined with GKS for residual tumor, as well as for small recurrences provides long-term disease control with a good quality of life.

Methods:
A total of 360 patients were treated with GKS or microsurgery between 1998 and 2013 by a single surgeon. Tumors < 2.2 cm in greatest dimension were treated with GKS alone, while tumors > 2.2 cm in greatest dimension were treated with a combination facial nerve-sparing subtotal resection if indicated and GKS of residual. All tumor recurrence was treated by GKS if possible. We retrospectively report on clinical, radiographic, and surgical outcomes.

Results:
Of the 360 patients treated for CPA meningiomas, 123 (34.2%) underwent microsurgical resection and 237 (65.8%) were treated with GKS alone. Preliminary data indicate that 44% of patients treated with microsurgery later required GKS for tumor recurrence at an average of 34.1 months after the initial surgery. A facial-nerve sparing strategy of subtotal resection combined with GKS for residual tumor results in excellent preservation of relevant cranial nerve function and long-term control of tumor growth.

Conclusions:
Safe subtotal resection combined with GKS may provide optimal long-term control of tumor growth with reduced morbidity in patients with meningiomas of the CPA.

Cavernous hemangiomas of the internal auditory canal and cerebellopontine angle

Link, Michael
Michael J Link MD[2,1], Colin L Driscoll MD[1,2], Michael S Oldenburg MD[1], Kathryn M Van Abel MD[1], Matthew L Carlson MD[1,4], Caterina Giannini MD[3], Jeffrey Jacob MD[2], Alejandro Rivas MD[4]

[1]Department of Otolaryngology-Head and Neck Surgery, [2]Department of Neurologic Surgery, [3]Department of Anatomic Pathology Mayo Clinic School of Medicine, Rochester, MN USA 55905 [4]Department of Otolaryngology-Head and Neck Surgery, Vanderbilt University Medical Center, Nashville, TN USA 37232

Objective:
To review the clinical presentation, differential diagnosis, management strategy and outcomes following microsurgical resection of cavernous hemangiomas(CH) arising primarily within the internal auditory canal(IAC) and cerebellopontine angle(CPA).

Study Design:
Retrospective case review

Setting:
Two tertiary academic referral centers

Patients:
Twelve patients (10M;age 18-66) were included from 1982-2012

Intervention(s): All patients underwent pre-operative imaging evaluation and subsequent microsurgical resection

Main Outcome Measure(s):
AAO-HNS hearing class, facial nerve(FN) function and tumor control.

Results:
The most common presenting symptoms were ipsilateral sensorineural hearing loss, non-pulsatile tinnitus, and vertigo. Three presented with facial paresis, 10 had lost serviceable hearing preoperatively. All lesions demonstrated heterogeneous enhancement with gadolinium and hyperintense signal on T2-weighted imaging. The median tumor diameter was 8mm; 8 CH were confined to the IAC while 4 involved the CPA.

Tumors were accessed via a translabyrinthine approach in 8 cases, retrosigmoid craniotomy in 3 cases, and a middle cranial fossa approach in one case. Ten patients received gross total resection, while 2 underwent subtotal removal. Neither patient with serviceable preoperative hearing retained useful hearing following resection. Eight of the 9 patients with normal preoperative FN function retained House-Brackmann grade 1 function following surgery. One patient had residual tumor treated with post-operative stereotactic radiosurgery.

Conclusions:
Primary CH of the IAC and CPA are rare and present clinically and radiographically similar to VS. Microsurgical resection provides excellent facial nerve outcomes and tumor control for most patients; however, the majority of individuals will acquire non-serviceable hearing either from disease or as a result of treatment.

5-year Bibliometric Profiles for 103 U.S. Neurosurgical Residency Program

Madison, Michael *MD*.
Paul Klimo Jr., Doug Taylor
University of Tennessee, Memphis

Object:
Recent efforts have attempted to define and usefully apply bibliometrics to neurosurgery. We aim to provide a comprehensive assessment of current publishing output from 103 U.S. neurosurgical residency programs and investigate intradepartmental publishing equality.

Methods:
Every institution was considered a single entity with each faculty member's five-year academic yield (measured in publications and citations from year 2009 through 2013) compiled to compute the following indices: ih(5), cumulative h, ig(5), ie(5), and i10(5). In addition, Gini coefficients for publications and citations. National and regional comparisons were made, institutions were ranked, and intradepartmental publishing equality was assessed.

Results:
The median departmental number of faculty, total publications and citations, ih(5), summed h, ig(5), ie(5), i10(5), and Gini coefficients for publications and citations were 13, 82, 716, 12, 144, 23, 16, 17, 0.57, 0.71, respectively. The top five most academically productive neurosurgical programs based on ih(5)-index were University of California San Francisco, University of California Los Angeles, University of Pittsburgh, Brigham & Women's Hospital, and Johns Hopkins University. The Western U.S. region was most academically productive and displayed greater intradepartmental publishing equality (median ih(5)-index= 18, median Ginipub= 0.56). Multivariable logistic regression analysis identified the ih(5)-index as the only independent predictor of Ginipub < 0.5 [OR 1.20, 95% confidence interval 1.20-1.40, p=0.03].

Conclusion:
The ih(5)-index is a simple, intuitive metric capable of accurately capturing recent scholarly efforts of neurosurgical institutions. It limits influence from individuals and predicts

intradepartmental publication equality. Institutional ranking by ih(5)-index can promote discussion to facilitate successful research. Future research productivity should be assessed using the ih(5)-index.

The Mythology of Neurosurgical Origins

Nanda, Anil, MD
Department of Neurosurgery at LSU Health Sciences Center at Shreveport, LA

Mythology has a cultural appeal and the origin of neurosurgical procedures in Greek, Hindu, Egyptian and Chinese mythology has a bearing to the origins of our professions. In Greek mythology, Zeus has an intractable headache and cannot be cured of this until Hephaestus uses his axe to split the skull of Zeus, giving birth to Athena and preforming a craniotomy on the Greek god and relieving his headache. In Hindu mythology, Ganesha the son of Shiva, was protecting his mother Parvati and had not seen his father, who enraged by his protective behavior, cuts his head off. His wife who is inconsolable then asks him to repair him immediately, and Shiva, finding an elephant transplants his head onto the infant Ganesha. This is probably the earliest record of a neurosurgical brain transplant performed. In Egyptian mythology, the goddess Isis

working with the god Thoth resurrects Osiris by treating his numerous damaged organs and putting them back together, but making the cervical spine the nidus of this regeneration. Thus the intact spine becomes an artistic symbol in Egyptian painting with a djed column. In Chinese mythology, Huo Tuo, a famous doctor who lived in the era of the three kingdoms, performed a craniotomy on Cao Cao, the King of the Wei Kingdom, to treat his severe headache caused by a brain tumor, but there is no formal historical record of this story or the story that Buddha's personal physician performed a brain tumor resection during his period. A series of historical illustrations showing the development of neurosurgery in mythology will be presented through the prism of different cultures, thus explaining the historical basis of our art.

The Economic Realities of Neurosurgical CME: It is Friday and Sunday is Coming. A view from the other side of the fence.

Origitano, Thomas, MD.
Neuroscience and Spine Institute
Kalispell Regional Health Care
Kalispell, Montana

Traditionally, neurological surgeons have acquired the necessary cme credit through attendance of national meetings. The shifting socio-economic climate may be changing this paradigm. Neurological surgeons are converting from a private model to an employed model. This has imposed restrictions on travel and limitations on educational funding. We performed a limited survey to an equal group of academic and non-academic neurological surgeons. The following questions were asked:

1) Employment status
2) Amount of educational stipend($0-5000, 5001-10,000, 10,000+)
3) Allocation of educational stipend (includes dues and registrations)
4) Number of days for education (0, 1-7, 7-10, 11+)
5) How CME acquired
6) Participation in MOC
7) RVU productivity compensation model

One hundred percent of responders answered that they were employed by their health system in both academic and non-academic group. Educational stipends for academic responders were statistically higher (64% vs. 37% , $5-10k, 36% vs. 0%, >$10k,) with 63% of the non-academics educational stipend being capped at $5K. In all cases the educational stipend included organizational dues. The academic responders also had more time off for education with 73% have greater than 10 days (vs. 0%) . The majority of non-academics received between 1-7 days for educational purposes (63%). The non-academics were more likely to answer that they acquired CME from local hospital sources than academics whom were more likely to receive the bulk of their CME from national meetings. An equal number of respondents in both groups were participating in MOC. The majority of academic respondents were on a RVU compensation model (56%).

In this limited study there appears to be differences in the amount of time and dollars allocated to education between academic and non-academic neurological surgeons. These differences may be a driving force in acquisition of CME through non-traditional sources (web based and hospital based vs. national meetings). Another interesting finding is the growth of productivity compensation in academics which is directly affected by time away from practice. These socio-economic issues may affect the course of neurosurgical educational programming in the near future.

BYLAWS

OF

THE SOCIETY OF UNIVERSITY NEUROSURGEONS, INC

ARTICLE 1

NAME AND OBJECT

Section 1. This organization shall be known as "The Society of University Neurosurgeons, Incorporated."

Section 2.

The objectives of this Society shall be: to promote scientific and social discourse among its members, to encourage investigative work in the neurological sciences, to improve teaching methods and techniques in neurological surgery, and to inspire its members to acquire humanistic ideals and to achieve clinical excellence in the practice of medicine."

To:

"Vision:

To enhance academic neurosurgeons throughout the world and improve the state of clinical and laboratory neuroscience globally

Mission Statements:

a) To improve the exchange of new ideas and scientific disclosures

b) To enhance comprehension of global activities, university settings, and specific regional challenges in the academic sector

To mentor and direct emerging academic neurosurgeons during the midcareer period

Section 3. No part of the income or property of this Society shall inure to the

benefit of any individual.

ARTICLE II

MEMBERSHIP QUALIFICATIONS

Section 1. The membership of the Society shall be divided into five classifications.

(a) Active

(b) Senior

(d) Honorary

(e) Inactive

A member shall be elected as provided in Article V- CANDIDATES FOR

MEMBERSHIP

Section 2. Classification of Membership

(a) ACTIVE. Active members shall be neurological surgeons who have been certified by the American Board of Neurological Surgery, Inc., or are certificants of The Royal College of Physicians and Surgeons (Neurosurgery) of Canada and who are engaged in the practice of Neurological Surgery.

(b) SENIOR. An Active member may, upon request to and approval of the Executive Council, transfer to Senior membership upon attaining the age of sixty (60) years or upon retirement from practice of neurological surgery. Senior members may not vote or hold office but may serve on Committees; and are not required to pay dues or regularly attend annual meetings.

(d) HONORARY. Honorary members shall be chosen as recognized leaders in the field of neurological sciences. They shall not exceed five in number. They shall not be required to pay dues or attend annual meetings. They shall not vote or hold office but may serve on committees.

(e) INACTIVE. Inactive members shall be former Active members who by virtue of illness or other reasons can no longer maintain Active membership and are not eligible for any other classification of membership. An Active member may, upon request to and approval of the Executive Council, transfer to Inactive status. An Inactive member may be restored to Active status by request to and approval of the Executive Council. Inactive members shall not vote, hold office or serve on Committees. They shall not be required to pay dues or attend annual meetings.

Section 3. Qualifications for Membership.

The Membership Committee shall be cognizant of the objectives of the Society and shall

recommend for membership individuals who are affiliated with a medical school or outstanding clinic. If an Active member ceases to comply with the membership requirements as provided in Section 2(a), he/she must resign from the Society or be transferred to a different membership classification. Individual exception to this rule requires recommendation by the Executive Council and approval by majority vote of the Active membership.

Section 4. Limitation of Membership:

The number of Active members in the Society may be limited upon recommendation of The Executive Council and approval by a majority vote of the Active membership. Honorary members shall not exceed five in number at any time.

ARTICLE III

OFFICERS

Section 1. The officers of the Society shall be President, President Elect, Vice-President, and

Secretary/Treasurer. The Executive Council shall be composed of the officers, one Active Member-at-Large appointed by the President, and the Immediate Past-President of the Society.

Section 2. The Nominating Committee shall present a slate of proposed officers to be elected for the succeeding year at each annual meeting. Active members present at the meeting may

make additional nominations. Election of officers shall be by ballot; the member receiving the largest number of votes cast for that office shall be elected. Officers so elected shall take office at the close of that annual meeting.

Section 3. Vacancy of an office shall be filled by an appointee of the Executive Council.

Section 4. The President shall serve for a term of one (1) year. He/She shall preside at all meetings and decide all questions of order,appoint committees and cast the deciding vote in ties.

Section 5. The President Elect shall be elected at each annual meeting. He/She shall become

President of the Society at the close of the subsequent annual meeting.

Section 6. The Vice-President shall assist the President. He/She shall preside at functions and

meetings in the absence of the President.

Section 7. The Secretary/Treasurer shall serve for a term of three (3) years. The Executive Council shall determine at which year the election for Secretary/Treasurer will be held. He/She shall keep records of attendance and minutes of each meeting, read all correspondence to the Society, handle all notices and correspondence of the Society. He/She shall account for the finances of the Society, collect dues and notify members of delinquent standing. He/She shall receive all applications for membership or guest attendance and forward this information to the Membership Committee at least one month prior to the annual meeting.

Section 8: The Executive Council shall be the governing body of the Society and have charge of activities of the Society not otherwise provided in these Bylaws. The Executive Council shall work in close coordination with the Membership Committee concerning the proposal of candidates for membership in the Society.

Section 9: The Historian of the Society shall maintain and update the Society of University yearbooks, which should document the scientific and social programs of the yearly meeting.

ARTICLE IV

MEETINGS

Section 1. The Society shall meet annually in the Spring or Early Summer at a site determined by the Future Sites Committee

Section 2. The annual meeting shall be a three day scientific program preceded or followed by a weekend as determined by the Program Committee. The scientific presentations shall be

balanced between clinical and investigative topics. **Section 3.** The Chairman of the Program Committee shall serve as Host for the annual meeting, assisted by his/her Committee and will be responsible for arrangements of both social and scientific activities during the meeting.

Section 4. Robert's Rules of Order (Revised) shall govern the conduct of the business meetings of the Society and the duties of its officers. The order of business shall consist of a roll call, reading of minutes, reading of correspondences, old business, new business, election of new members, reports of committees, the Secretary/Treasurer's report, election of officers, appointment of committees, and adjournment.

Section 5. Members of any class shall be assessed a pro rata share of the expenses of the annual meetings which they attend.

ARTICLE V

CANDIDATES FOR MEMBERSHIP

Section 1. Candidates for membership shall have the qualifications as provided in Articles 1,2, & 3.

Section 2. No candidate shall be elected to Active membership who has not attended at least one annual meeting as a guest.

Section 3. Each candidate shall be nominated in writing to the Secretary/Treasurer at least two (2) months prior to the next annual meeting. The nomination shall include the candidate's curriculum vitae and a statement of his/her present academic and professional status. The

completed proposal for membership shall be forwarded to the Membership Committee

for consideration. The Membership Committee shall present to the Executive Council their recommendations for new members. On approval of the Executive Council, candidates shall be proposed to the Active Membership for written secret ballot at the annual meeting of the Society. Election of a member requires affirmative vote of three fourths (3/4) of the Active members present and voting at the annual meeting.

Section 4. The Membership Committee shall present no more than five (5) candidates for active

membership each year with no requirement of a minimal number to be presented.

Section 5. The Secretary/Treasurer shall notify each candidate elected to membership not earlier than two (2) weeks following the date of his/her election and collect a membership initiation and certificate fee, the amount to be determined each year by the Executive Council.

Section 6. A candidate who has failed to be elected may be reconsidered at subsequent annual

meeting upon written request of three (3) Active members to the Executive Council.

ARTICLE VI

DUES

Section 1. All Active members of the Society shall be assessed annual dues, the amount to be

determined each year by the Executive Council.

Section 2. Dues are payable in advance for the succeeding year at the time of or immediately

following the annual meeting, at the discretion of the Secretary/Treasurer.

ARTICLE VII

STATUS OF MEMBERS

Section 1. All members shall be in good standing when abiding by the Bylaws of the Society.

Section 2. An Active member shall be suspended when dues or assessments have not been paid for the previous two (2) years. If he/she fails to attend two (2) consecutive annual meetings

and does not present an excuse acceptable to the Executive Council, a warning letter will be sent. If an active member fails to attend three consecutive meetings, then his/her membership will be terminated.

Section 3. A member may be suspended or dropped from any class of membership in the Society by an affirmative vote of three-fourths (3/4) of the Active membership.

ARTICLE VIII

COMMITTEES

Section 1. The Society may have standing and ad hoc committees as determined by the President and the Executive Council. There shall be at least four standing committees:

Membership Committee. Nominating Committee, Future Sites Committee and Program

Committee.

Section 2. The Membership Committee shall be composed of three (3) members, one to be elected at large each year to serve a term of three (3) years. The senior member of the

Committee shall serve as Chairman. This Committee shall review nominations for new

members and present the applications of the most worthy and desirable candidates to the

Executive Council. The names of the candidates approved by the Executive Council shall be submitted to a vote by the Active membership at the next annual meeting of the Society.

Section 3. The Executive Council shall serve as the Nominating Committee, with the Immediate

Past-President of the Society as Chairman.

Section 4. The President taking office at the close of the annual meeting shall appoint the Program Committee each year. The Chairman of the Committee shall be the Host for the next

annual meeting. The Program Committee may invite guests to complement the scientific

program of the meeting

Section 5. The Future Sites Committee shall be composed of three (3) members, one to be elected at large each year to serve a term of three (3) years. The senior member of the Committee shall serve as Chairman. This Committee shall recommend the site of future meetings, at least three years in advance.

Section 6. The Bylaws Committee shall make recommendations to the Executive Committee by proposing amendments to the bylaws, rules, and regulations. The Bylaws Committee will be composed of three (3) to six (6) members, each serving a term of up to three (3) years. Recommendations so approved will then be voted upon by the Membership via email ballot or at the Annual Meeting.

Section 7. The Senior Advisory Committee shall make recommendations to the Executive Committee for maintaining the Vision and Mission of the Organization. Senior Advisory Committee members will be able to attend Executive Committee meetings. This Committee will be composed of three (3) to six (6) members, each serving a term of up to three (3) years

ARTICLE IX

GUESTS

Section 1. The Society shall encourage the presence of guests at its annual meeting.

Section 2. Certain invited guests of the Society shall not pay a registration fee or be charged for a share of the group expenses of the meeting. Such guests shall include individuals approved by the Executive Council.

Section 3. “Individual guests to the annual meeting may be invited by members. The member shall notify the Secretary/

Treasurer of the name and address of his/her proposed guest, and the

Secretary/Treasurer shall officially invite the guest to the meeting.

ARTICLE X

AMENDMENTS

Section 1. Amendments to these Bylaws may be made by a proposal in writing from a member of the Executive Council at any time. The amendment shall be voted on at the subsequent

annual meeting. The Secretary/Treasurer shall notify all Active members in writing of the proposed amendment prior to the annual meeting, and such amendment shall require for adoption an affirmative vote of three fourths (3/4) of the Active members present and voting.

Section 2. Amendments to the Bylaws and voting procedures may also be conducted by email. The Secretary will notify members by email of the need to vote on an Amendment to the Bylaws, permitting 14 days for voting. Such proposed amendments shall require for adoption an affirmative vote of three quarters (3/4) of the Active Members responding. Amendments to the Bylaws and voting procedures may also be conducted by email. The Secretary will notify members by email of the need to vote on an Amendment to the Bylaws, permitting 14 days for voting. Such proposed amendments shall require for adoption an affirmative vote of three quarters (3/4) of the Active Members responding

RULES AND REGULATIONS

Of

THE SOCIETY OF UNIVERSITY NEUROSURGEONS, INC.

SUBJECT 1

MEMBERSHIP

Section 1. Candidate Profile

(a) Candidates should be less than 48 years of age

(b) Candidates should be committed to an academic career

(c) Candidates should have sufficient publications that the quality of their academic activity can be evaluated

(d) Candidates should have attended a SUN meeting, presented a paper before the Society, and expressed an interest in the Society.

(e) Candidates should have potential for hosting a future SUN meeting.

Section 2. Membership Process

(a) Candidates must have attended at least one SUN meeting and presented at least one paper to the Society before being recommended for membership

(b) No voting for membership will occur at the meeting where the candidate is a guest and presents a paper to the Society

(c) The membership process would be initiated by obtaining the membership application form from the Secretary of the Society

(d) Upon completion the form would be returned to the Secretary who, following documentation of its completeness, would forward it to the Chair of the

Membership Committee

(e) The candidate is proposed for membership to the Membership Committee and a recommendation is made to the Executive Committee based on the candidate's profile

(f) At the next regular meeting, the candidate is brought forward for membership during the first business session

(g) If elected by the membership, the candidate will be invited to membership and upon joining the Society, is then eligible to attend the next regular meeting

Shanghai
China

2015

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THE SOCIETY OF UNIVERSITY NEUROSURGEONS