THE
AMERICAN ACADEMY
OF
NEUROLOGICAL SURGERY

73rd Annual Meeting

The Fairmont Scottsdale Princess
Scottsdale, Arizona

October 19-22, 2011

American Association of Neurological Surgeons

Jointly Sponsored by AANS

FUTURE MEETINGS

2012

October 17-20, 2012
Chatham Bars Inn
Chatham/Cape Cod, Massachusetts

2013

September 25-28, 2013
The Resort at Pelican Hill
Newport Beach, California

Mark your calendars now!

GENERAL INFORMATION

HOTEL INFORMATION

The Fairmont Scottsdale Princess
7575 East Princess Drive
Scottsdale, Arizona 85255
United States

REGISTRATION DESK LOCATION AND HOURS:

Wednesday, October 19	East Foyer A	12:00 PM – 6:30 PM
Thursday, October 20	East Foyer A	6:00 AM – 12:00 PM
Friday, October 21	East Foyer A	6:00 AM – 12:00 PM
Saturday, October 22	East Foyer A	6:00 AM – 12:00 PM

PROGRAM SUMMARY

WEDNESDAY, OCTOBER 19

EVENTS	TIME	LOCATION
Registration	**12:00 PM-6:30 PM**	**East Foyer A**
ABNS Advisory Council Meeting	**1:30 PM-3:00 PM**	**Sonoran Room**
Academy Executive Comm. Mtg	**3:00 PM-5:00 PM**	**Sonoran Room**
Opening Reception	**6:30 PM - 9:30 PM**	**Princess Plaza**

THURSDAY, OCTOBER 20

EVENTS	TIME	LOCATION
Registration	**6:00 AM-12:00 PM**	**East Foyer A**
Continental Breakfast (Members)	**6:30 AM-7:30 AM**	**Sonoran Room & Patio**
Continental Breakfast (Spouse/Guest)	**6:30 AM-10:30 AM**	**Salon 5 South Pool Overlook**
General Scientific Session	**7:30 AM-12:00 PM**	**Salon A-C**
***The Desert Blooms*—Harry Estep**	**10:30 AM**	**Sonoran Room**
Lunch		**At Leisure on Own**
Afternoon Leisure Activities	**see Leisure Services Concierge to schedule**	
Golf Tournament-Stadium Course	**12:00**	
Reception/Buffet Dinner	**6:30 PM-**	**La Hacienda Plaza & Trellis**

FRIDAY, OCTOBER 21

Registration	**6:00 AM-12:00 PM**	**East Foyer A**
Breakfast (Members)	**6:30 AM-7:30 AM**	**Sonoran Room & Patio**
Breakfast (Spouse and Guest)	**6:30 AM-10:30 AM**	**Salon 5 South Pool Overlook**
General Scientific Session	**7:30 AM-1:00 PM**	**Salon A-C**
Documentaries and Discussion --Mari Rutka	**10:30 AM**	**Sonoran Room**
Presidential Address	**11:55 AM**	**Salon A-C**
Lunch	**At Leisure On Own**	
Afternoon Leisure Activities	**See Leisure Services Concierge to schedule**	
Golf—Champions Course	**1:00 PM**	
Presidential New Member Reception (by invitation)	**6:00 PM**	**Presidential Suite**
Black Tie Optional Reception	**6:30 PM-7:30 PM**	**East Foyer A-F**
Black Tie Optional Dinner	**8:00 PM-11:30 PM**	**Salon D E, South Corridor**

SATURDAY, OCTOBER 22

Registration	**6:00 AM-12:00 PM**	**East Foyer A**
Breakfast (Members/Guests)	**6:30 AM-7:30 AM**	**Sonoran Room and Patio**
Breakfast (Spouse)	**8:00 AM-9:30 AM**	**Salon 5C**
General Scientific Session	**7:30 AM-1:00 PM**	**Salon A-C**

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73rd Annual Meeting

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Mission Statement:

The purpose of the live Academy meeting shall be to promote scientific and social interaction among its members, to foster neurological surgery as specialty of medicine, to encourage and sponsor basic and clinical research activity in the neurological sciences, and to promote the knowledge and skill of those who devote themselves to neurological surgery in accordance with the high ideals of the medical profession.

This activity will include live presentations from faculty to include case presentations, discussion, as well as time for questions and answers.

American Academy of Neurological Surgery

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Learning Objectives

Upon completion of this educational activity, participants should be able to:

- Explain the possibilities of bio-prostheses to patients
- Design better clinical trials for glioma treatment
- Compare the current techniques available to treat aneurysms
- Identify the techniques to treat a variety of brain tumors
- Review advances in spinal surgery techniques

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Accreditation Statement

This activity has been planned and implemented in accordance with the Essential Areas and policies of the Accreditation Council for Continuing Medical Education (ACCME) through the joint sponsorship of the American Association of Neurological Surgeons (AANS) and American Academy of Neurological Surgery. The AANS is accredited by the Accreditation Council for Continuing Medical Education (ACCME) to provide continuing medical education for physicians.

Designation Statement

The AANS designates this live educational activity for a maximum of 13.25 hours of *AMA PRA Category 1 Credit*s™. Physicians should claim only the credit commensurate with the extent of their participation in the activity.

Intended Audience/Background Requirement

The scientific program presented is intended for neurosurgeons either in training or in active practice.

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AMERICAN ACADEMY OF NEUROLOGICAL SURGERY

SCIENTIFIC PROGRAM AGENDA 2011

THURSDAY, October 20, 2011		
Time	**Presentation**	**Presenter**
7:30 – 8:40	**Brain-Machine Interface and Beyond**	
7:30 – 7:45	BMI-State of the Art	Eric Leuthardt, MD
7:45 – 8:05	Muscle-Machine Interface	Sanjay S. Joshi, PhD
8:05 – 8:30	Exoskeletons: For Soldiers and Patients	LTC Joseph Hitt, PhD
8:30 – 8:40	Questions and Discussion	Panel
8:40 – 9:30	**Glioma Biology and Therapy: New Insights**	*Moderator*: Paul McCormick, MD
8:40 – 8:48	Cancer Stem Cells in Glioblastoma Can Give Rise to Endothelium	Viviane Tabar, MD
8:48 – 8:56	Glioma Associated-Mesenchymal Stem Cells Increase Hallmarks of Glioma Stem Cell aggressiveness through the IL6/STAT3 Pathway	Frederick F. Lang, MD
8:56 – 9:04	Hades Trident Therapy: Application of Antibody Guided Nanosyringes in the Treatment of Glioblastoma	David Baskin, MD
9:04 – 9:12	Intra-arterial Bevacizumab to target the glioma stem cell niche – from bedside to bench and back again	John A. Boockvar, MD
9:12 – 9:20	Progress of a Phase II Trial of the mTOR Inhibitor Everolimus (RAD001) in Patients with Recurrent Low Grade Glioma (LGG)	Mitchel S. Berger, MD
9:20 – 9:30	Questions and Discussion	Panel
9:30 – 9:50	**Pediatric Neuro-oncology**	
9:30 – 9:38	Preclinical Use of Mild Hyperthermia to Enhance Drug Delivery of Liposomes into Pediatric Brain Tumors	Gerald Grant, MD
9:38 – 9:46	Results of A Pilot Study to Evaluate the Effects of Vaccinations with HLA-A2-Restricted Glioma Antigen-Peptides in Combination with Poly-ICLC for Children	Ian F. Pollack, MD

	with Newly Diagnosed Malignant Brain Stem Gliomas (BSG), Non-Brainstem High-Grade Gliomas (HGG), or Recurrent Unresectable Gliomas	
9:46 – 9:50	Questions and Discussion	Panel
9:50 – 10:10	**Craniopharyngiomas: Techniques and Outcome**	
9:50 – 9:58	Maximizing the Operative Approach in Craniopharyngioma in Children: Impact of Anterior Clinoid Removal and Dissection of the Dura Propria	Michael L. Levy, MD, PhD
9:58 – 10:06	Impact of Surgeon Experience on Outcomes of Craniopharyngioma Resection in Children: A Single Surgeon Experience of 117 Surgeries	Jeffrey Wisoff, MD
10:06 – 10:10	Questions and Discussion	Panel
10:10 – 10:30	BREAK	
10:30 – 11:00	**Skull Base Tumors: The Good, The Bad and The Pretty**	
10:30 – 10:38	Sphenoid Wing Meningiomas: Single Center Experience	Michael W. McDermott, M.D
10:38 – 10:46	Resection of Skull Base Malignancies – A 20-year perspective	Franco DeMonte, MD
10:46 – 10:54	Significant Improvements in Health Related Quality of Life after Endoscopic Anterior Skull Base Surgery: A Prospective Study	Theodore Schwartz, MD
10:54 – 11:00	Questions and Discussion	Panel
11:00 – 11:30	**Functional Neurosurgery**	
11:00 – 11:08	Comprehensive *in vivo* mapping of the basal ganglia and thalamic connectome in individual subjects, using high resolution 7T MRI	Aviva Abosch, MD
11:08 – 11:16	From Movement Disorders to Modulation of Limbic Dysfunction: Deep Brain Stimulation and the Neurocircuitry of Reward	Kelly D. Foote, MD
11:16 – 11:24	Engineering the Optimal Neuromodulation Paradigm for Medically Intractable Temporal Lobe Epilepsy	Charles Y. Liu, MD
11:24 – 11:30	Questions and Discussion	Panel

11:30 – 11:50	**Subspecialty Training, Certification and MOC**	
11:30 – 11:37	A proposed mechanism for recognizing subspecialty training in neurological surgery	Robert E. Harbaugh, MD
11:37 – 11:44	Commentary	Cameron McDougall, MD
11:44 – 11:50	Questions and Discussion	Panel
11:50 – 12:20	**Academy Award Presentation**	
11:50 – 11:55	Awards Presentation	Matthew Howard, MD
11:55 – 12:15	Neuromodulation in Animal Models of Motor Diseases: Optogenetic Tools for Dissecting the Motor Circuitry of the Cortico-Basal Ganglia Loop	Paul Kalanithi, MD
12:15 – 12:20	Questions and Discussion	Panel
FRIDAY, October 21, 2011		
7:30 – 8:15	**Vascular Malformations**	*Moderator*, Robert Friedlander, MD
7:30 – 7:37	Surgery for Eloquent Cerebral AVMs	Kazuhiro Hongo, MD
7:37 – 7:44	ROCK Inhibition as Therapy in Cerebral Cavernous Malformation	Issam Awad, MD
7:44 – 7:51	The failure of preoperative ethylene-vinyl alcohol copolymer embolization to improve outcomes in AVM management: Case series	Michael K Morgan, MD
7:51 – 7:58	Management of Pediatric Intracranial Arteriovenous Malformations: Experience with Multimodality Therapy	Gary K. Steinberg, MD, PhD
7:58 – 8:05	Multimodality Treatment of Conus Medullaris AVMs: Two Decades of Experience with Combined Endovascular and Microsurgical Treatments	Robert F. Spetzler, MD
8:05 – 8:12	“Surgical” intracranial dural arteriovenous fistulas	Roberto C. Heros, MD
8:12 – 8:20	Questions and Discussion	Panel

8:20 – 8:56	**Cerebral Aneurysm Detection, Monitoring and Outcome**	
8:20 – 8:28	Automated Detection of Intracranial Aneurysms Using Writhe Number Analysis of the Cerebral Vasculature in 3-D Space	Adel M. Malek, MD, PhD
8:28 – 8:36	Relationship of Growth to Aneurysm Rupture in Asymptomatic Aneurysms ≤ 7 mm: A Systematic Analysis of the Literature	Bernard R. Bendok, MD
8:36 – 8:44	Correlation of Changes in Intraoperative SSEPs During Aneurysm Surgery with Postoperative Stroke Rates	Rafael Tamargo, MD
8:44 – 8:52	Language and cognitive disturbances after aneurysmal SAH: the impact of treatment	Hildo Azevedo-Filho MD, PhD
8:52 – 8:56	Questions and Discussion	Panel
8:56 – 9:25	**Large and Giant Aneurysms: What Have We Learned**	
8:56 – 9:04	Large and Dysmorphic MCA Aneurysms: Tandem Clipping and Interlocking Clipping Techniques	David Chalif, MD
9:04 – 9:12	Giant Cerebral Aneurysms: Operative Nuances and Outcome	Anil Nanda, MD
9:12 – 9:20	Giant Intracranial Aneurysms: Evolution of Management in a Contemporary Series	Michael T. Lawton, MD
9:20 – 9:25	Questions and Discussion	Panel

9:25 – 9:45	**Endovascular Adjuncts and Approaches for Complex Aneurysms**	
9:25 – 9:33	Fusion of Intraoperative 3-Dimensional Rotational Angiography and Flat-Panel Detector Computed Tomography for Cerebrovascular Neuronavigation	Howard A. Riina, MD
9:33 – 9:41	Endovascular Treatment of Fusiform Posterior Circulation Aneurysms: A Decade of Evolution	Ricardo A Hanel, MD PhD
9:41 – 9:45	Questions and Discussion	Panel

9:45 – 10:01	**Flow-diversion: Life-line or Pipe-dream**	
9:45 – 9:53	Pipeline Embolization of Paraclinoid Aneurysms: Experience with 34 Cases	Giuseppe Lanzino, MD
9:53 – 10:01	Flow Diversion Devices for Aneurysms: Ready for Prime Time? Heck No!	Jacques Morcos, MD
10:01 – 10:21	BREAK	
10:21 – 11:46	**Generating the Evidence: Randomized Clinical Trials and Beyond**	
10:21 – 10:36	Lumbar Spinal Fusion Reduces Risk of Re-operation after Laminectomy for Lumbar Spinal Stenosis with Grade I Degenerative Spondylolisthesis: The SLIP trial and Neuropoint SD	Zoher Ghogawala, MD
10:36 – 10:51	National Neurosurgery Quality and Outcomes Database (N^2QOD): The Role of Registries in the generation of Evidence – Opportunities and Challenges	Anthony Asher, MD
10:51 – 11:21	Applying a patient-specific bio-mathematical model to enhance our evaluation of treatment effects: Lessons learned from Glioma	Kristin Rae Swanson, PhD
11:21– 11:41	Alternatives to Randomized Clinical Trials: Stories from the world of education and non-surgical science	Stephen West, PhD
11:41– 11:46	Questions and Discussion	Panel
11:46 – 11:50	Introduction of the President	Jeffrey N. Bruce, MD
11:50 – 12:20	**Presidential Address:** **In Pursuit of Excellence in Neurosurgery: Lessons from the Sports World**	**Robert A. Solomon, MD**
SATURDAY, October 22, 2011		
7:30 – 8:30	**Spine Forum: Guidelines, Outcomes, Adult Scoliosis and Minimally Invasive**	*Moderator*, E. Sander Connolly, MD
7:30 – 7:38	Management of Acute Cervical Spine and Spinal Cord Injury: The New Guidelines	Mark N. Hadley, MD
7:38 – 7:46	Assessment of Thecal Sac Decompression Following	Richard G. Fessler, MD, PhD

	Lumbar Decompression: Minimally Invasive versus Open Approaches	
7:46 – 7:54	Impact of Patient Age on Complication Rates and Two-year Clinical Outcome following Surgical Treatment for Adult Scoliosis	Justin S. Smith, MD, PhD
7:54 – 8:02	Long-term Outcomes of Lumbar Fusion Among Workers' Compensation Subjects An Historical Cohort Study	Russell Travis, MD
8:02 – 8:10	Exogenous Crosslink Therapy: New Hope for Disc Degeneration	Phillip A. Tibbs, MD
8:10 – 8:18	A Prospective Analysis of Incidental Durotomy During Spinal Surgery – 3000 Cases Performed in an Academic Institution.	Allan D. Levi, MD
8:18 – 8:30	Questions and Discussion	Panel
8:30 – 8:40	**Publish *Anew* or Perish?**	
8:30 – 8:38	Development and Initial Use of a New Platform for Writing, Review, Publication and Use of the Scientific Literature	Douglas Kondziolka, MD
8:38 – 8:40	Questions and Discussion	Panel
8:40 – 8:50	**Veins: There for the Taking?**	
8:40 – 8:48	Cerebral Veins: "To Sacrifice or Not to Sacrifice, that is the question"	M. Samy Elhammady, MD
8:48 – 8:50	Commentary	Steven L. Giannotta, MD

9:00 – 9:20	**Zen and the Art of Pediatric Neurosurgery**	
9:00 – 9:08	Influence of Dural Opening on Syringomyelia and Scoliosis in Children with Chiari I Malformations	Richard C.E. Anderson MD
9:08 – 9:16	Using Statistical Process Control Methodology to Decrease the Shunt Infection Rate at a Children's Hospital	Corey Raffel, MD
9:16 – 9:20	Questions and Discussion	Panel

9:20 – 9:50	**Technical Adjuncts in the Surgical Management of Brain Tumors**	
9:20 – 9:28	Dye Enhanced Confocal Endomicroscopy Improves Visualization of Histopathological Features in Brain Tumors	Peter Nakaji, MD
9:28 – 9:36	Contemporary Uses of Laser Interstitial Thermal Therapy	Gene H. Barnett, MD, MBA
9:36 – 9:44	Surgery vs. Radiosurgery for the Treatment of Mid-sized Brain Metastasis	Raymond Sawaya, MD
9:44 – 9:50	Questions and Discussion	Panel
9:50 – 10:10	**Neuro-recovery and Neuro-repair: Basic Science**	
9:50 – 9:58	Epigenetic pathways modulate repair of the injured CNS	Bermans J. Iskandar, MD
9:58 – 10:06	Development of a neuroma-in-continuity injury model in rodents	Rajiv Midha, MD
10:06 – 10:10	Questions and Discussion	Panel
10:10 – 10:30	BREAK	
10:30 – 11:10	**Hemorrhagic and Ischemic Stroke**	
10:30 – 10:38	Tamoxifen is an effective neuroprotectant in an endovascular canine model of ischemic stroke	Alan S. Boulos, MD
10:38 – 10:46	The Myth of Restenosis After Carotid Angioplasty and Stenting	Felipe C. Albuquerque, MD
10:46 – 10:54	Minimally-invasive endoscopic and Image-guided evacuation of Intracerebral hemorrhage: Technique and results in 38 cases	Neil Martin, MD
10:54 – 11:02	Moyamoya disease: Current concepts and future perspectives in clinical and basic research in Japan	Kiyohiro Houkin, MD
11:02 – 11:10	Questions and Discussion	Panel
11:10 – 12:00	**Schwannomas: Do We Have Consensus?**	
11:10 – 11:18	Does Low Dose Radiation Exposure Lead to the Development of Acoustic Neuromas?	L. Dade Lunsford, MD

11:18 – 11:26	Should Anything Be Done To Preserve Hearing In Patients With Intracanalicular Vestibular Schwannomas?	Stephen J. Haines, MD
11:26 – 11:34	Microsurgery and Gamma Knife Radiosurgery for Vestibular Schwannoma: A Balanced Approach	Basant Misra MBBS, MS, MCh
11:34 – 11:42	"Lip Service"	Michael B. Sisti, MD
11:42 – 11:50	Bevacizumab treatment for 31 progressive NF2-related vestibular schwannomas: hearing and volumetric responses and duration of response	Fred G. Barker II MD
11:50 – 12:00	Questions and Discussion	Panel

SCIENTIFIC PROGRAM

THURSDAY, OCTOBER 20

7:45 – 8:05 EXPLORING NEUROMUSCULAR PLASTICITY FOR NEW BRAIN-MUSCLE-COMPUTER INTERFACES

Sanjay S. Joshi, PhD
Associate Professor, Department of Mechanical & Aerospace Engineering, College of Engineering, University of California, Davis

ABSTRACT
The human brain has shown an amazing ability to adapt to the tasks it routinely confronts. This plasticity has been studied in many different contexts, but its limits are yet to be fully understood. More recently, brain plasticity has shown itself in the field of brain-computer interfaces (BCI), in which persons learn to actively elicit specific brain signals in order to control external devices. In our work, we have been developing a new human-computer interface based on human neuromuscular plasticity. In these brain-muscle-computer interfaces, a single surface electromyogram (sEMG) signal acts as a signal generator to drive external devices. Persons employ an operant conditioning framework to learn how to manipulate a single muscle site's sEMG to create specific complex electrical signals, which are not necessarily related to muscle movement. Thus far, we have been using the Auricularis superior (ear-wiggling) muscle, as even those persons with high spinal cord injury can access face muscles. Our recent results show severely paralyzed persons can use such devices to control computer cursors, wheelchairs, and appliances. Ultimately, effective interfaces will both allow the machine to adapt to the user, and allow the user to adapt to the machine. If successful, both brain-computer interfaces and brain-muscle-computer interfaces could positively impact quality of life for many people.

BIOGRAPHY
Sanjay Joshi is Associate Professor of Mechanical and Aerospace Engineering at the University of California, Davis, where he directs the Robotics, Autonomous Systems, and Controls Laboratory. Dr. Joshi received a BS from Cornell University in 1990, and MS/PhD from UCLA in 1992/1996, all in Electrical Engineering. After his doctoral work, he became a member of the technical staff at the NASA Jet Propulsion Laboratory in Pasadena, California working on control systems and robotics. After joining academia, he began applying autonomous robotics and controls to the study of behavior, cognition, and human-computer interfaces. He has recently returned from sabbatical, where he was Visiting Associate Professor at Columbia University Medical School, New York City in the Department of Neurology.

8:40 – 8:48 CANCER STEM CELLS IN GLIOBLASTOMA CAN GIVE RISE TO ENDOTHELIUM

Viviane Tabar, MD

Glioblastoma (GBM) is among the most aggressive of human cancers. Extensive neo-vascularization and abnormal blood vessels are characteristic and defining features of these tumors. Yet the mechanisms of angiogenesis and specifically, the origin of tumor endothelial cells remain poorly defined. In this work, we demonstrate that a subpopulation of endothelial cells within glioblastomas harbor the same somatic mutations identified within tumor cells, such as amplification of the EGFR amplicon and chromosome 7, suggesting a neoplastic nature. We additionally demonstrate that the cancer stem cell $CD133^{+}$ fraction includes a subset of vascular E-cadherin-expressing cells that display characteristics of endothelial progenitors capable of maturation into endothelial cells.

Extensive in vitro and in vivo lineage analyses, including single cell clonal studies, further show that the cancer stem cells in glioblastoma are multipotent and capable of differentiation along the endothelial lineage via this intermediate progenitor cell. The findings are supported by genetic studies of specific exons selected from The Tumor Cancer Genome Atlas, quantitative FISH and comparative genomic hybridization data, that demonstrate identical genomic profiles in the tumor stem cells, their endothelial progenitor derivatives and the mature endothelial cells.

Exposure to the clinical anti-angiogenesis agent bevacizumab (Avastin) or to a γ-secretase inhibitor resulted in distinct effects: blocking VEGF inhibits the maturation of endothelial progenitors into tumor endothelium but does not stop cancer stem cells from becoming endothelial progenitors, while γ-secretase inhibition blocks the conversion of cancer stem cells into endothelial progenitors. These cells are bipotential and capable of initiating aggressive tumors, possibly explaining the mechanisms of failure of anti-angiogenesis inhibitors currently in use .The lineage plasticity and capacity to generate tumor vasculature of the putative cancer stem cells within glioblastoma are novel findings that provide new insight into the biology of gliomas and the definition of cancer stemness, as well as the mechanisms of tumor neo-angiogenesis.

8:48 – 8:56 GLIOMA ASSOCIATED-MESENCHYMAL STEM CELLS INCREASE HALLMARKS OF GLIOMA STEM CELL AGGRESSIVENESS THROUGH THE IL6/STAT3 PATHWAY.

Anwar Hossain, PhD and ***Frederick F. Lang, MD, FACS, FAANS***

Introduction: Although the tumor micro-environment is increasingly recognized as an important determinant of the biological behavior of cancer, for glioblastomas (GBMs), detailed analyses of the micro-environment and the effects of the micro-environment on tumor-initiating glioma stem cells (GSCs) have been lacking. In this context, we recently isolated from primary surgical GBM specimens cells resembling human bone marrow mesenchymal stem cells (hMSCs), which we call Glioma-Associated hMSCs (GA-hMSCs). In order to prove that GA-hMSCs are not merely passive bystanders within GBMs, we sought to test the hypothesis that GA-hMSCs are capable of actively driving phenotypic hallmarks of aggressive behavior (proliferation, stemness, and tumorgenicity) in GSCs.

Methods and Results: To determine the extent to which GA-hMSCs isolated from human gliomas influence the proliferation of gliomas, GSCs (N=3) were placed in the lower wells of Transwell plates and GA-hMSCs (N=5) were placed in the upper wells. As controls, "neural stem cell" media (NSC media) or human brain microvascular endothelial cells (HBMEC) were placed in the upper wells. Co-culture with GA-hMSCs significantly increased the number of GSCs compared with NSC media or HBMEC, indicating that GA-hMSCs have the capacity to increase the proliferation of GSCs. To determine whether GA-hMSCs are capable of enhancing GSC self-renewal (stemness), GSCs were seeded as single cells in 96-well plates and grown in NSC media (control) or conditioned media (CM) from GA-hMSCs or HBMECs (control). After 4 weeks, the percentage of wells containing GSC neurospheres was significantly greater after exposure of GSCs to CM from GA-hMSCs compared with control media or HBMECs, indicating that GA-hMSCs have the capacity to increase the self-renewal of GSCs. To determine whether these *in vitro* results also occurred *in vivo*, GSCs (bottom well) were co-cultured with GA-hMSCs (upper well) or controls (NSC media or HBMECs) and after 7 days GSCs were injected into the frontal lobes of nude mice (N=10 mice/group). The median survival of mice injected with GSCs co-cultured with CM from GA-hMSCs was significantly shorter compared with that of mice injected with GSC grown in control CM. In a separate experiment, 80% of mice implanted with small numbers (10^2 or 10^3 cells/mouse) of GSCs that were co-cultured with GA-hMSC CM developed tumors compared with mice implanted with GSCs co-cultured with control CM (20-40%, $P<0.001$). Together these studies indicated that GA-hMSCs are capable of increasing the tumorigenicity and growth of GSCs in vivo. To begin to define the mechanisms underlying the effects of GA-hMSCs on GSCs, we tested GA-hMSCs using an antibody-based cytokine array and found that GA-hMSCs secreted high levels of IL-6. To prove a causal role for IL-6 in hMSC-enhanced GSC proliferation, GSCs were co-cultured with GA-hMSCs and an inhibitory antibody to IL-6 or a control antibody was added to the wells. GA-hMSCs-enhanced proliferation of GSCs was significantly attenuated by inhibitory IL-6 antibody, indicating that IL-6 at least partly mediates the effects of GA-hMSCs on GSC growth. To begin to define the molecular changes that take place in GSCs after exposure to GA-hMSCs, GSCs were co-cultured with GA-hMSCs and whole cell lysates of GSCs were assayed by Western blotting using phospho-specific antibodies against STAT-3, which is downstream of IL-6 receptor. Compared with controls, co-culture with GA-hMSCs resulted in significant increases in phospho-STAT3, suggesting a role for STAT3 in mediating the effects of GA-hMSCs on GSCs.

Conclusions: We conclude that GA-hMSCs are a previously unrecognized component of the GBM micro-environment that are capable of driving GSCs toward a more aggressive phenotype by increasing GSC proliferation, capacity for self renewal and in vivo tumorigenicity and growth, potentially through the secretion of IL-6, which acts on GSCs by activating STAT3. These studies suggest that the micro-environment of GBMs is more complex than previously thought and that targeting GA-hMSCs may represent a new therapeutic paradigm for GBMs.

8:56 – 9:04 HADES TRIDENT THERAPY: APPLICATION OF ANTIBODY GUIDED NANO-SYRINGES IN THE TREATMENT OF GLIOBLASTOMA

David Baskin, MD, FACS[(1),] *Daniela Marcano, PhD* [(2)], *Jim Tour, PhD* [(2)], *Martyn Sharpe, PhD* [(1)].

[1] *Department of Neurosurgery, The Neurological Institute, Methodist Hospital, Houston, TX.* [2] *Smalley Institute for Nanoscale Science and Technology, Rice University, Houston, TX*

INTRODUCTION: Glioblastoma multiforme (GBM) is the most common and most aggressive malignant primary brain tumor. Prognosis is poor, with median survival time of 14 months. Hydrophilic/hydrophobic carbon clusters (HCC) are highly soluble PEG functionalized and fractured carbon nanotubes. HCCs have three properties that allow them to be used as nano-syringes: extremely low biological toxicity, a highly hydrophobic core that can be loaded with drugs and an ability to strongly bind to proteins, including IgG antibodies.

The **H**CC, **A**ntibody, **D**rug, **E**nhancement **S**ystem (HADES), is a methodology we are developing whereby HCCs are used to transport hydrophobic drugs toward specific cell types. HCCs are filled with hydrophobic compounds and antibodies are bound to the PEG matrix. When presented to cells, the antibodies will bind to the chosen surface antigen and the drug will partition from the hydrophobic core and into the cells.

We have filled HCCs with three potent, hydrophobic, chemotherapeutic agents that were chosen as they can theoretically act synergistically: SN-38, Vinblastine and Doxetaxel.

We selected antibodies to surface antigens that were highly expressed in these GBM; glial fibrillary acidic protein (GFAP), the interleukin-13 receptor (Il-13R) and the epidermal growth factor receptor (EGFR). We have investigated the ability of HADES to kill 6 different primary human glioma cultures, using a combination of three drugs and antibodies: Trident Therapy. We also examined the same conditions (that proved to be highly lethal in GBM) in human primary astrocytes and neurons.

METHODS: In high throughput analysis the total cellular protein mass was measured using the BCA method. Living/dead cell numbers were measured, via epifluorescence microscopy, using a range of independent measures of viability: the DNA stain Hoechst, the plasma membrane potential probe Dead Green, *dd*TUNEL which measures 3'OH DNA ends, *in situ* ligation of blunt-ended DNA breaks, Caspase-3 activity levels and Mitotracker Red.

RESULTS: The three drugs, SN-38, Vinblastine and Doxetaxel, were all toxic toward primary GBM cultures, when targeted using IgG's toward GFAP, Il-13R or EGFR. Control experiments, where HCC, drug loaded HCC and or the antibodies were added to cells independently, showed no toxicity of any of the HADES components in any of the cell types.
Toxicity of the chemotherapeutics was dependent on the particular proliferation rate of each of the tumors, with rapidly proliferating cells being the most vulnerable to treatment. A synergistic increase in cell death was observed using Trident therapy, where GBM cells were incubated with all three drugs, which were targeted to the cells using the three antibodies.
Toxicity towards primary human astrocytes and neurons was statistically insignificant, and the imaged cells showed little evidence of drug induced death pathway activation.

CONCLUSION: Nanotechnology, in the form of antibody directed nano-syringes, offers a way to target cells that bear a particular surface antigen, with a drug. Using HADES we demonstrate how GBM may be treated in the future; targeting chemotherapeutic agents only toward cancer cells that have unregulated, specific, surface antigens.

9:04 – 9:12 INTRA-ARTERIAL BEVACIZUMAB TO TARGET THE GLIOMA STEM CELL NICHE – FROM BEDSIDE TO BENCH AND BACK AGAIN

***John A. Boockvar, M.D.**, Jan-Karl Burkhardt, M.D. and Howard Riina, M.D.*

Department of Neurological Surgery, New York-Presbyterian Hospital, Weill Cornell Medical College, New York, NY

Introduction: Malignant gliomas, including its most fatal form glioblastoma multiforme (GBM), remain challenging to treat due to their unresponsiveness to therapy. For recurrent tumors, bevacizumab (BV), which directly binds to vascular endothelial growth factor (VEGF) that is released by endothelial cells and brain tumor stem-like cells (TSC) in the perivascular niche, is a promising treatment agent. We hypothesize that selective intra-arterial niche disruption/delivery (SIAND) of BV including selective intra-arterial cerebral infusion (SIACI) of BV after blood-brain barrier disruption (BBBD), leads to a higher tumor drug concentration in the perivascular niche and therefore targets TSC more effectively than intra-venous (IV) BV treatment.

Methodology: 45 patients with malignant gliomas from our completed phase I and ongoing phase II clinical trials were treated with SIACI BV to access safety, cost effectiveness and outcome compared to conventional intra-venous (IV) delivery. In addition, an *in vivo* orthotopic mouse xenograft model based on patient derived TSC was initiated to evaluate treatment effects of SIAND.

Results: IA delivery of BV is safe to a dose of 15mg/kg in the treatment of patients with malignant gliomas. Toxicity attributed to the IA BV treatment was similar to previously reported IV BV trials and we show that IA BV is significantly more cost effective than conventional IV therapy. Using the recently updated Response Assessment in Neuro-Oncology Working Group (RANO) criteria, the median progression-free survival (PFS) of our first 14 patients, who were BV naïve before IA treatment was 10 months compared with 3.7 to 4.2 months with IV BV. IA BV treated mice after BBBD showed a higher BV tumor drug concentration compared to IA BV alone and intra-peritoneal (IP) treated animals.

Conclusions: SIACI and SIAND of bevacizumab is safe for the treatment of patients with malignant gliomas. Our human results and *in vivo* animal data are promising, suggesting higher treatment response and cost effectiveness compared to conventional IV delivery. Outcome and side effects will be further determined by ongoing phase II trials.

9:12 – 9:20 PROGRESS OF A PHASE II TRIAL OF THE mTOR INHIBITOR EVEROLIMUS (RAD001) IN PATIENTS WITH RECURRENT LOW GRADE GLIOMA (LGG)

Mitchel S. Berger, MD*; Sabine Mueller, MD, PhD; William A. Weiss, MD, PhD; Michael D. Prados, MD; Nicholas Butowski, MD; Jennifer Clarke, MD; Daphne A. Haas-Kogan, MD; Susan Chang, MD*

All from University of California, San Francisco

Our studies of adult LGGs document that whereas mutation of PTEN is common in *de novo* malignant gliomas, methylation of the PTEN promoter is an alternate mechanism of PTEN inactivation that likely underlies PI3K activation in approximately half of adult and pediatric LGGs. Pre-clinical and clinical studies have demonstrated that tumors with PI3K pathway activation are more sensitive to treatment with mTOR inhibitors.

These findings provided the rationale of a single-arm, phase II trial of the mTOR inhibitor everolimus (RAD001; Affinitor®; Novartis) for adults with recurrent LGGs. The primary objective is to determine progression-free survival at 6 months associated with use of everolimus in patients initially diagnosed with low-grade glioma who undergo biopsy or subtotal resection at the time of recurrence with pathological evidence of recurrent gliomas. Surgery must be done within 4 months of enrollment in the study and tissue must be available for molecular analysis.

The planned total accrual is 60 patients. To date, 24 patients have enrolled, of whom 11 continue on active treatment and remarkably, 3 continue to have stable disease on everolimus for over a year despite multiple prior recurrences. This study continues to accrue patients, and we have begun molecular studies to test the hypothesis that those tumors with PI3K/mTOR activation are more likely to respond to everolimus.

9:30 – 9:38 PRECLINICAL USE OF MILD HYPERTHERMIA TO ENHANCE DRUG DELIVERY OF LIPOSOMES INTO PEDIATRIC BRAIN TUMORS

***Gerald Grant, MD**, Christy Wilson, PhD, Shuqin Li, MS, David Needham, PhD, Mark Dewhirst, DVM, PhD, Darell Bigner, MD PhD,*

All authors from Duke University.

INTRODUCTION: The inability of chemotherapy drugs to cross the blood-brain barrier and reach brain tumors at a therapeutic concentration is a major limitation. Methods for applying mild hyperthermia in peripheral tumors outside of the CNS has been studied, but the applicability of these methods to enhance drug delivery to brain tumors is novel. Current methods of hyperthermia treatment for brain tumors involve inserting probes, lasers, or antennas to locally generate heat and ablate tumors, which strategy is invasive and requires monitoring to ensure proper placement.

METHODS: The current work is a feasibility study on the use of a surface-based miniature microwave applicator to focally heat brain tumors through a cranial window to enhance drug delivery to a brain tumor. 25-28g CD1 nu/nu mice were anesthetized, placed in a stereotaxic frame, and a 4mm x 6mm bone flap was removed. Dura was then excised and 10^6 456 human xenograft glioblastoma tumor cells were injected into the right hemisphere and a cranial window was placed. After 12-14 days, mild hyperthermia was achieved by applying a specially designed microwave applicator ipsilateral to the tumor. The power (heat) deposition of the applicator was optimized using a 3D numerical model of the mouse brain and electromagnetic simulation software. Doxorubicin (Dox) was delivered using low temperature-sensitive liposomes (LTSLs) that release at 41.5°C and intravital confocal microscopy was used to visualize the distribution of Dox into the brain tumor.

RESULTS: Confocal microscopy showed that Dox released from the LTSLs following mild hyperthermia (4-5°C) penetrated deeper into the tumor tissue compared to Dox alone or under normothermic conditions. The ability to apply mild hyperthermia non-invasively to brain tumors can significantly enhance the delivery of chemotherapeutics as measured by concentration and depth of penetration.

CONCLUSIONS: This study shows promise that thermosensitive liposomes can be delivered across the blood-brain barrier into a brain tumor following mild hyperthermia and that a miniature microwave applicator approach is a feasible option for such heating.

9:38 – 9:46 RESULTS OF A PILOT STUDY TO EVALUATE THE EFFECTS OF VACCINATIONS WITH HLA-A2-RESTRICTED GLIOMA ANTIGEN-PEPTIDES IN COMBINATION WITH POLY-ICLC FOR CHILDREN WITH NEWLY DIAGNOSED MALIGNANT BRAIN STEM GLIOMAS (BSG), NON-BRAINSTEM HIGH-GRADE GLIOMAS (HGG), OR RECURRENT UNRESECTABLE GLIOMAS

Ian F. Pollack, M.D., FACS, FAAP, FAANS*; Regina I. Jakacki, M.D., Lisa H. Butterfield, Ph.D. Hideho Okada, M.D., Ph.D.), Children's Hospital of Pittsburgh and the University of Pittsburgh Cancer Institute, University of Pittsburgh Medical Center*

INTRODUCTION: Malignant astrocytomas of the brainstem and cerebral hemispheres are among the most deadly brain tumors of childhood, and most children succumb within several years of diagnosis, despite current treatments. New therapeutic approaches are needed that target the unique features of these tumors. During the last decade, we have gained significant preclinical and clinical experience with immunotherapy for adult gliomas, and extended these insights to the treatment of childhood gliomas, based on our observations regarding their profiles of glioma-associated antigen (GAA) expression.

METHODOLOGY: We initiated a pilot trial of subcutaneous vaccinations with synthetic peptides for GAA epitopes emulsified in Montanide-ISA-51 every 3 weeks for 8 courses, and intramuscular administration of poly-ICLC in HLA-A2+ children with newly diagnosed malignant brainstem gliomas (BSG), cerebral high-grade gliomas (HGG), or recurrent gliomas. GAAs for these peptides were EphA2, interleukin (IL)-13 receptor-α2, and survivin. The primary endpoints were safety and T cell responses against vaccine-targeted GAAs, assessed by ELISPOT analysis of interferonγ-producing antigen-specific T-cells and tetramer analysis of GAA-reactive T-cells. Treatment response was evaluated clinically and by MR imaging.

RESULTS: To date, 18 children have been enrolled, 10 with newly diagnosed BSG treated with irradiation, 4 with newly diagnosed HGG treated with irradiation and concurrent chemotherapy, two with recurrent HGG, and two with treatment-refractory low-grade glioma. No dose-limiting toxicity has been encountered. One child with a BSG had transient tumor enlargement 4 months after beginning vaccination (7 months after irradiation) that later regressed and culminated in a sustained partial response (PR), consistent with pseudoprogression. Two other children with BSG who had transient neurologic deterioration followed by subsequent stabilization also remain alive > 1 year from diagnosis without further intervention. Principal toxicities have included injection site reactions and low grade fevers, which have been mild. Among 16 patients evaluable for response, 12 had sustained stable disease, 1 had a PR, and 1 has a continuing complete response after surgery. Thirteen patients exceeded the expected median progression-free survival for BSG or HGGs, and 6 are on long-term maintenance vaccine therapy. Seven of 10 BSG patients have survived > 11 months after diagnosis. ELISPOT analysis, completed in five children, showed response to IL13Rα2 in 4, EphA2 in 2, and survivin in 1. Tetramer responses to both IL13Rα2 and EphA2 were also noted. Tissue was available for antigen expression in four children, and all showed immunoreactivity for at least two vaccine antigens.

CONCLUSION: Our preliminary results demonstrate that a multipeptide approach to vaccination in children with gliomas is well tolerated, and has evidence of both immunological and clinical activity for these challenging tumors. The applicability of this approach in the context of other surgical and adjuvant treatment options for childhood gliomas will be discussed.

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9:50 – 9:58 MAXIMIZING THE OPERATIVE APPROACH IN CRANIOPHARYNGIOMA IN CHILDREN: IMPACT OF ANTERIOR CLINOID REMOVAL AND DISSECTION OF THE DURA PROPRIA

Michael L. Levy, MD, PhD, *Professor and Head, UCSD/RCHSD Division of Pediatric Neurosurgery*

Maximizing excision is the singular variable most predictive with regard to decreasing tumor recurrence. Given the complexity of tumors that involve the sellar and parasellar, third ventricular, cavernous, and interpeduncular fossa regions we have reviewed our prospective database of children undergoing fronto-orbitozygomatic (+/- temporo-polar) craniotomy.

In our current series of 54 patients (30 males, 78.6 + 56.2 mo), 39 were < 18 years. Of 33 Initial approaches there were 8 temporo-polar and 8 combined approaches. 17 patients undergoing orbitozygomatic approaches alone were excluded. The tenets underlying the approach include: 1) maximizing and decreasing trajectory to the suprasellar region, interpeduncular fossa, and anterior third ventricle; 2) bone removal (orbital roof, and middle fossa, 3) posterior mobilization of the temporal tip, and 4) skeletonization/decompression of cranial nerves and vascular structures to maximize preservation during surgical manipulation.

Benefits and complications related to the approach will be contrasted with cases using alternative approaches. Approach decisions based upon a modified understanding of existing classification systems based on the vertical projection of tumor growth with respect to the sella turcica, the optic chiasm, and the floor of the third ventricle will be discussed (i.e. laterality of the suprasellar component and postero-inferior extent with regard to the posterior clinoid).

9:58 – 10:06 IMPACT OF SURGEON EXPERIENCE ON OUTCOMES OF CRANIOPHARYNGIOMA RESECTION IN CHILDREN: A SINGLE SURGEON EXPERIENCE OF 117 SURGERIES

Jeffrey Wisoff, MD, *New York University, New York, NY*

INTRODUCTION: Preliminary evidence suggests a correlation between surgeon experience and improved oncological and functional outcomes in children with craniopharyngiomas.

METHODS: We retrospectively analyzed the records of 100 consecutive children (40 females/60 males; mean age: 9.7 years) who underwent a total of 117 attempted radical resections by a single surgeon. Functional status before and after surgery was assessed using the Craniopharyngioma Clinical Status Scale (CCSS). Dividing the cases into quartiles of 29 surgeries, regression analysis was used to assess the impact of surgeon experience on extent of resection and complications.

RESULTS: All primary tumors were completely removed and the mean rate of complete resection for recurrent tumors was 60.8%. Preoperative COS scores predicted postoperative outcome better than clinical characteristics like patient age, sex, tumor size, location or presence of hydrocephalus. Controlling for differences between groups, multivariate regression analysis revealed increasing surgeon experience to be correlated with less deterioration in neurological, hypothalamic and cognitive functioning at latest follow-up. There was no impact on pituitary or visual outcomes.

CONCLUSIONS: The surgical philosophy of attempted radical resection did not change during the 25-year experience as evidenced by the stable extent of resection over time. Preoperative CCSS scores predicted outcome more highly than clinical or imaging characteristics. However, increasing surgeon experience with craniopharyngioma resection correlated with improved neurological, hypothalamic and cognitive outcomes. Such data support the notion of early referral of children with craniopharyngiomas to centers with high volume.

THURSDAY, OCTOBER 20

10:30 – 10:38 SPHENOID WING MENINGIOMAS: A SINGLE INSTITUTION EXPERINCE

Michael E. Sughrue, M.D., Martin J. Rutkowski, B.A., C. Jared Chen, Gopal Shangari, A.B., Ari J. Kane, B.A., Andrew T. Parsa, M.D., Mitchel S. Berger, M.D., and ***Michael W. McDermott, M.D****.*

UCSF Department of Neurosurgery

INTRODUCTION: Sphenoid wing meningiomas were first described in detail by Cushing, distinguishing between globoid tumors with a nodular shape and en plaque tumors which are flat and spread along the sphenoid wing. The globoid tumors were further categorized into three groups: 1) medial, 2) middle, and 3) lateral. We reviewed the experience of surgical resection of meningiomas of the sphenoid wing at a single center, to examine whether if this classification predicts clinical presentation and post-surgical outcome.

METHODS: We identified all patients undergoing surgical resection of sphenoid wing meningioma at our institution over a 9 year period. We compared clinical data from patients with tumors arising at different points along the sphenoid wing to determine if these tumors behaved differently in terms of symptoms, radiographic characteristics, and post-surgical outcome.

RESULTS: A total of 56 underwent microsurgical resection for sphenoid wing meningioma during this period. The rate of optic canal invasion (medial 52% vs. middle 5% vs. lateral 0%, χ^2 $p<0.0001$), supraclinoid ICA encasement (medial 32% vs. middle 5% vs. lateral 0%, χ^2 $p<0.01$), and MCA encasement (medial 45% vs. middle 24% vs. lateral 0%, χ^2 $p<0.01$) were all highest with medial third tumors. New or worsened neurologic deficits occurred in 11/56 (20%) of patients. Of all the imaging characteristics studied, only location of the tumor along the medial third of the sphenoid wing significantly predicted an increased rate of new or worsened neurologic deficit (OR 2.7, $p<0.05$).

CONCLUSIONS: Our data seem to suggest that globose meningiomas of the sphenoid wing are clinically and surgically reducible into two distinct entities, the medial third sphenoid wing tumors, and the lateral parasylvian sphenoid wing tumors. Insights into complication avoidance will also be presented.

10:38 – 10:46 RESECTION OF SKULL BASE MALIGNANCIES: A 20-YEAR PERSPECTIVE

Franco DeMonte, MD, FRCSC, FACS. *Professor of Head and Neck Surgery, Mary Beth Paweleck Chair in Neurosurgery, The University of Texas MD Anderson Cancer Center, Houston, TX*

INTRODUCTION: Malignancy of the skull base is rare and few centers have the opportunity to amass much experience in the management of these complex patients. Over the course of 20 years at one of the nation's largest comprehensive cancer centers approximately 460 patients with malignancy affecting the skull base had surgery as part of the management of their disease. Data collected from this group of patients as well as from patients with sinonasal malignancy have been reviewed and several publications have ensued. This presentation summarizes those studies and identifies continued surgical limitations to optimal patient outcome.

METHODOLOGY: All patients operated upon by the author for malignancy involving the skull base were identified from the Neurosurgical departmental database. Similarly all patients with surgically treated sinonasal malignancies were identified from the Head and Neck departmental database and reviewed with express interest on tumor histology. Prospectively collected data was retrospectively reviewed based on the particular hypothesis being examined. Patient outcomes were analyzed by skullbase site, tumor histology, perineural, transdural, infratemporal and cavernous sinus extension, surgical technique, patient age, and the presence of metastatic disease. An evaluation of patient quality of life was also performed using both general and specific measures.

RESULTS: Site specific patient 2year overall survival for eh anterior, anterolateral and sphenoid sinus was 63%, 81% and 55% respectively. 5-year overall survival based on tumor histology was 89% for olfactory neuroblastoma, 85% for low-grade sarcoma, 71% for adenoid cystic carcinoma, 66% for high-grade sarcoma and 38.7% for mucosal melanoma. 5year disease specific survival for purely endoscopic tumor resection was 86% compared to 92% for a cranio-endoscopic technique. Disease specific survival was not found to be significantly different between a group of young patients (mean age 56) and a group with a mean age of 70 years. Well selected patients with perineural, transdural and infratemporal fossa extensions of malignancy all had 5year survivals of approximately 50%. Conversely patients with ICA and cavernous sinus extension had markedly reduced survival. The majority of patients with metastases to the skullbase were successfully palliated. Quality of life was not adversely affected when specific measures were used but was diminished in 30% when general measurement tools were utilized.

CONCLUSIONS: Despite varied tumor sites and extensions, tumor histology, patient age and surgical technique overall 5year survival for well selected patients remains in excess of 505. Specific histologies, sites and extensions may be associated with 5-year survivals in excess of 80%. Important exceptions include cavernous sinus and ICA involvement by malignancy and melanoma pathology. Successful palliation is possible for patients with metastasis to the skullbase. Quality of life is not typically diminished by the surgical procedure but is negatively altered by the psychosocial changes and adjustments that accompany the disease and its treatment.

10:46-10:54 SIGNIFICAN IMPROVEMENTS IN HEALTH RELATED QUALITY OF LIFE AFTER ENDOSCOPIC ANTERIOR SKULL BASE SURGERY: A PROSPECTIVE STUDY

***Theodore Schwartz, MD**, Cornell University, New York NY*

BACKGROUND: Outcomes research is becoming increasingly important in assessing the success of surgical interventions. Skull base surgery has traditionally been evaluated based on extent of resection, time to progression and survival. Endoscopic skull base surgery (ESBS) is a minimal-access technique that provides an alternative to traditional transcranial and microscope-assisted approaches that may lead to improvements in quality of life since natural orifices are used to reach the pathology.

OBJECTIVE: To assess the impact of ESBS on site-specific QOL using a validated instrument, the Anterior Skull Base Questionnaire (ASBQ), and on sinonasal-related QOL using the Sinonasal Outcome Test (SNOT-22).

METHODS: Patients undergoing ESBS were prospectively enrolled from a tertiary referral center. All patients completed the ASBQ and SNOT-22 preoperatively and again postoperatively at regular intervals. Univariate analyses were performed.
Results: Fifty-three consecutive patients underwent ESBS, of which 46 were included for study. Pathology was predominantly pituitary adenoma (56.5%) and the sella was the most commonly involved structure (60.9%). There was no significant decline in ASBQ QOL at 3- and 6-weeks, with significant improvements in QOL at 12-weeks and 6 months ($p<0.05$). Improvements were noted in emotional well-being at 3- and 6- weeks and in all domains at 6 months ($p<0.05$). Pre-operative QOL was significantly worse for revision surgery and significantly improved post-operatively for gross-total resection at 6- and 12-weeks ($p<0.05$). Scores on the SNOT-22 worsened at 3-weeks and then returned to baseline at 12-week and 6 months. SNOT-22 scores were correlated with ASBQ scores at each time point up to 12 weeks postoperatively ($r>0.60$). The presence of a nasoseptal flap or a graft donor site did not contribute to decreased QOL.

CONCLUSIONS: ESBS is associated with improvement of postoperative site-specific QOL as compared to preoperative QOL. Short-term improvements are higher if GTR is achieved but at 6 months this factor is not significant. Sinonasal QOL transiently declines and then returns to its pre-operative baseline. ESBS is a valuable tool in the neurosurgical management of midline anterior skull base pathology that leads to increases in health related quality of life.

11:00-11:08 COMPREHENSIVE IN VIVO MAPPING OF THE BASAL GANGLIA AND THALAMIC CONNECTOME IN INDIVIDUAL SUBJECTS, USING HIGH RESOLUTION 7T MRI

Aviva Abosch, *Christophe Lenglet, Essa Yacoub, Guillermo Sapiro, Noam Harel*

Basal ganglia and thalamic circuitry is affected in neurological disorders such as Parkinson's disease, essential tremor, dystonia and Tourette syndrome. Understanding the structural and functional connectivity of these circuits, and their interactions, is necessary for elucidating the mechanisms of movement and neuropsychiatric disorders. Such an understanding is also critical for the development of new therapeutic strategies and for improving existing ones, such as deep brain stimulation procedures. Knowledge about the connectivity patterns of the human basal ganglia and thalamus has rapidly evolved over the last two decades, but remains incomplete due to insufficient resolution of non-invasive imaging capabilities. We present an imaging and computational protocol designed to generate a comprehensive *in vivo* and subject-specific, three-dimensional model of the structure and connections of the human basal ganglia and thalamus.

A spectrum of high-resolution 7 Tesla MRI data were acquired, including T2- and susceptibility-weighted imaging (SWI), high angular resolution diffusion imaging, and resting-state functional imaging (R-fMRI). Capitalizing on the enhanced signal-to-noise ratio and enriched contrast obtained at high-field MRI, exquisite detail of the structural and diffusion properties of the human brain was achieved. This unique combination of an assortment of imaging modalities, with a customized computational pipeline, overcomes previous limitations such as insufficient resolution and contrast—which is especially noticeable in midbrain imaging. The new approach allowed for the precise visualization of basal ganglia components and thalamus, and the mapping of their connectome. Results from 4 healthy subjects, with a repeated data acquisition for one of these, are presented, including an array of reconstructed pathways and their probabilities. Also described are subject-specific, connectivity-based parcellations of the caudate nucleus, putamen, internal and external segments of the globus pallidus, substantia nigra, subthalamic nucleus and thalamus. These findings are supported and correlated with functional connectivity data from R-fMRI.

The imaging and analysis protocols used in this study yielded consistent results across subjects, between left and right hemispheres in individual subjects, and in different imaging modalities—as anatomical connectivity data corresponded to functional territories identified by R-fMRI. Based on the data presented here, we propose an updated model of the basal ganglia and thalamic connectome.

This work sheds new light on, and demonstrates new capabilities for investigating, basal ganglia and thalamic circuitry in humans. It also opens new avenues of investigation into the movement and neuropsychiatric disorders.

THURSDAY, OCTOBER 20

11:08-11:16 FROM MOVEMENT DISORDERS TO MODULATION OF LIMBIC DYSFUNCTION: DEEP BRAIN STIMULATION AND THE NEUROCIRCUITRY OF REWARD

Kelly D. Foote, MD *– University of Florida Dept of Neurosurgery*

INTRODUCTION: Despite our incomplete understanding of the mechanism of action of deep brain stimulation (DBS), the remarkable efficacy of DBS therapy for the treatment of movement disorders such as Parkinson's disease, tremor and dystonia has been clearly demonstrated. The dopamine-dependent motor network that has been so effectively modulated with DBS is remarkably analogous to the dopamine-dependent mesolimbic network whose dysfunction is associated with several important behavioral disorders, including obsessive-compulsive disorder (OCD), depression, schizophrenia, addictions, and impulse control disorders. The neurocircuitry of reward and aversion in the human is being elucidated through the use of animal model correlates and modern structural and functional imaging modalities. This phylogenetically primitive neural network is perhaps the most potent determinant of human behavior, and its malfunction can be disastrous for the affected individual. Our DBS group has been investigating the dysfunctional mesolimbic network both with experimental applications (DBS for OCD and depression, intraoperative microelectrode recording from the ventral striatum neurons during a decision making task) and with a recent retrospective analysis of behavioral disorders in a large cohort of carefully evaluated Parkinson's DBS patients. In this presentation, I will briefly review some of the more fascinating discoveries from our mesolimbic DBS-related experimental investigations, which have been presented in detail elsewhere, and I will present our findings from a recently completed retrospective study of the effect of DBS on behavioral disorders in patients with Parkinson's disease:

OBJECTIVE: Impulse control disorders (ICDs) and dopamine dysregulation syndrome (DDS) have recently been recognized as important behavioral problems that affect a subpopulation of patients with Parkinson's disease (PD) and typically result in markedly diminished quality of life for patients and their caregivers. We aimed to investigate the effects of subthalamic nucleus (STN) and internal globus pallidus (GPi) deep brain stimulation (DBS) on these issues.

METHODS: A retrospective chart review was performed on 159 individuals who underwent unilateral or bilateral PD DBS surgery in either STN or GPi. Pre- and post-operative records were reviewed to categorize patients both pre- and post-operatively as having: ICD, DDS, both ICD and DDS, or neither ICD nor DDS.

RESULTS: Twenty-eight patients were identified who met diagnostic criteria for ICD or DDS pre- or post-operatively. No significant correlation was found between patient outcome, medication usage, or target location. The findings from this study suggest that unilateral or bilateral DBS had no effect on DDS, even if medication reduction was realized. Furthermore, GPi vs. STN stimulation targets had no appreciable differential effect on DDS symptoms. ICD resolved in two patients following DBS. There was no significant decrease in dopamine agonist usage after either unilateral or bilateral DBS. Several patients who had not previously met the full diagnostic criteria for ICD or DDS developed these diagnoses post-operatively.

CONCLUSIONS: In this retrospective analysis, DBS did not result in significant improvement among patients with dopamine dysregulation syndrome, but was beneficial in a few cases of Parkinson-associated impulse control disorders. On the other hand, DBS was associated with the novel presentation of both DDS and ICD in a few patients. Based on currently available evidence, clinicians should not consider STN or GPi DBS to be a solution to Parkinsonian ICD or DDS. Rather, heightened sensitivity to the significant prevalence and profound impact of these Parkinson-related behavioral disorders is warranted, along with a more comprehensive approach to pre- and post-operative care. A reasonable treatment strategy for ICDs and DDS may include judicious reduction of dopaminergic medications and behavioral therapy, and patients should be carefully screened for ICDs and DDS before and after surgery. A larger, prospective study will be necessary to clarify the potential effect of DBS on these important behavioral disorders.

11:16-11:24 ENGINEERING THE OPTIMAL NEUROMODULATION PARADIGM FOR MEDICALLY INTRACTABLE TEMPORAL LOBE EPILEPSY

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For the past two decades, vagus nerve stimulation (VNS) has become standard in most modern epilepsy centers. Although long-term experience clearly demonstrate that a large number of patients achieve reductions in seizure burden with VNS, critics point out that only a few patients achieve seizure freedom. New clinical trials show promising results from deep brain stimulation (DBS) and responsive neurostimulation (RNS). However, the challenge remains to optimize the positive effect to tip risk/benefit considerations toward surgery. RNS differs from the other neurostimulation paradigms in that the target for stimulation is the specific focus of the seizure onset. This difference presents the potential to engineer an optimal approach for neurostimulation with respect to specific neuronal population to target, as well as the frequency, amplitude, duration, and pattern of stimulation. In this paper, we report on an approach that involves the development of an in vitro model for temporal lobe epilepsy involving human hippocampal slices harvested en-bloc as a byproduct of epilepsy surgery. This model is then used to identify specific neuronal populations within the hippocampal architecture that are most relevant for seizure onset, as well as the optimal neurostimulation paradigm to abort the seizures. The results of the in vitro experiments will then be used to validate complex mathematical models of hippocampal function that will further elucidate the role of neurostimulation and seizure control.

11:30-11:37 A PROPOSED MECHANISM FOR RECOGNIZING SUBSPECIALTY TRAINING IN NEUROLOGICAL SURGERY

Robert E. Harbaugh, MD, FAANS, FACS, FAHA, *Penn State University, Pennsylvania*

How best to recognize subspecialty training in Neurosurgery has been a problem that has involved the American Board of Neurological Surgery (ABNS), the Neurosurgery Residency Review Committee (Neurosurgery RRC) of the Accreditation Council for Graduate Medical Education (ACGME), the American Board of Medical Specialties (ABMS), the Society of Neurological Surgeons (SNS), the American Association of Neurological Surgeons (AANS), the Congress of Neurological Surgeons (CNS), the Congress of State Neurosurgical Societies (CSNS), the Leapfrog Group and others. I would like to propose a system to recognize subspecialty training in Neurosurgery.

The system would function as follows:

1. The ABNS would continue to be the only *certifying* organization for neurosurgeons and would continue to offer only a single certificate designation Board Certification in Neurological Surgery

2. Recognition of subspecialty proficiency would involve the SNS Committee on Accreditation of Subspecialty Training (CAST) process and include the following steps:

A. ABNS eligibility/certification,
B. Focused training in a CAST approved subspecialty program and
C. A letter from the CAST approved subspecialty program director indicating that a trainee had met the requirements for proficiency in that subspecialty.

The ABNS could support this system by offering more subspecialty options for the maintenance of certification cognitive examination. CAST recognition might then require trainees to pass these cognitive examinations to achieve recognition. The CNS and AANS could support this system by developing subspecialty specific educational opportunities. The role of the Neurosurgery RRC would remain unchanged.

This system would allow organized Neurosurgery to recognize individuals who have demonstrated proficiency in a Neurosurgery subspecialty during or after resident training, without requiring ACGME approval of new subspecialty certificates. It would be an incentive for residency programs to develop expertise in subspecialty areas and to seek CAST recognition for this expertise.

11:55-11:37 NEUROMODULATION IN ANIMAL MODELS OF MOTOR DISEASES: OPTOGENETIC TOOLS FOR DISSECTING THE MOTOR CIRCUITRY OF THE CORTICO-BASAL GANGLIA LOOP

Paul Kalanithi, MD, *Stanford University, Palo Alto, CA*

Optogenetic Modulation of the Primate Motor System: Progress and Challenges

Since their introduction in 2005, optogenetic techniques have been used with substantial success and versatility in transgemic rodent models of neuropsychiatric disease, allowing millisecond control of genetically specified neural populations, resulting in the technique being named Nature's Method of the Year in 2010. The cell-specificity and temporal precision of optogenetics represents a major technical advance over current techniques of neuromodulation, suggesting important applications in primate models, and possible human therapies, in treatment of neuropsychiatric disease and neural prosthetics.

We recently reported functionality of excitatory (ChR2, SFO) and inhibitory (eNpHR2.0) optogenetic tools in rhesus macaque cortex (Diester et al., *Nature Neuroscience* 2011). Surprisingly, despite reliably driving M1 activity, no behavioral modulation was elicited, suggesting the need for further refinement. Two major hurdles are addressed here: (1) the ability to modulate primate behavior; and (2) the ability to develop circuit specific nonhuman primate optogenetic tools. The potent red-shifted opsin C1V1 (Yizhar, et al, *Nature* 2011) presumably allows larger volumes of activation; it was paired with the CaMKIIα promoter to target excitatory neurons in a rhesus macaque premotor cortex. This allowed the first demonstration of this opsin in primates, and more significantly, allowed the first instance of optogenetic primate behavioral modulation. However, only subtle behavioral effects were able to be detected. Robust primate optogenetics may require development in a primate model with shorter time scales than rhesus. To address this, a squirrel monkey model for histological and electrophysiological analysis of primate optogenetic constructs was developed. Using stereotactic techniques, we intraoperatively injected fluorescent-labeled optogenetic constructs in multiple cortical and subcortical sites in squirrel monkeys and subsequently analyzed the neural circuits histologically for fluorescence using confocal laser microscopy and intraoperative electrophysiology.

We present evidence of the first nonhuman primate expression of further opsins under multiple promoters, using the AAV5 vector system, with electrophysiological confirmation. This opens the possibility of circuit specific modulation of neural populations in nonhuman primates. These steps forward may improve translation of a potential powerful tool for understanding and improving neurosurgical treatments of a variety of neurologic and psychiatric disorders.

FRIDAY, OCTOBER 21

7:30-7:37 SURGERY FOR ELOQUENT CEREBRAL AVMS

Kazuhiro Hongo, M.D., *Hisashi Nagashima, M.D., Tetsuya Goto, M.D., Tetsuyoshi Horiuchi, MD*
Department of Neurosurgery, Shinshu University School of Medicine

Introduction: Direct surgery for the cerebral arteriovenous malformation (AVM) especially that of the eloquent area is challenging. In this report, our surgical indication, strategy, techniques and results of the eloquent area AVM will be reported.

Materials and Methods: Between April 1999 and December 2010, 43 patients (20 men and 23 women, age ranged between 4 and 72 years, average age of 35.7 years, follow-up period of 11 to 140 months, were surgically treated. Lesions were sensorimotor in 19, visual cortex in 12, internal capsule in 5, internal capsule in 3, language in 2, brainstem in 1 and cerebellar peduncle in 1. Surgery was indicated for the superficially located lesion. For a high-flow AVM, it was preoperatively embolized with NBCA or Onyx. Detailed preoperative stereoscopic angiography was taken to identify feeding arteries to be occluded at surgery. Motor evoked potential (MEP) and/or somatosensory evoked potential (SEP) were monitored according to the location of the nidus. Nidus was meticulously resected from the surrounding brain just along the surface of the nidus under a high magnification.

Results: For the 43 patients, 48 surgeries were conducted: total removal in 37, subtotal in 4, feeder occlusion in 2, and ruptured in 34 patients, unruptured in 9. Preoperative embolization was performed in 11 patients. For the unruptured patients, good recovery was in 7 (78%), moderate disability in 2 (22%). For total patients with hemorrhagic patients, good recovery was in 24 (56%), moderated disability in 15 (35%), severe disability in 4 (9%), and no mortality. There were no reruptures.

Conclusions: With a detailed angiographical evaluation with/without preoperative embolization, and with marginal dissection of a nidus after adequate feeder obliteration, superficially located eloquent AVM can be removed with reasonable results.

7:37-7:44 ROCK INHIBITION AS THERAPY IN CEREBRAL CAVERNOUS MALFORMATION

Issam Awad, MD, MSc, FACS, *University of Chicago Medical Center*

BACKGROUND/HYPOTHESIS. No therapy exists to prevent the genesis and progression of cerebral cavernous malformations (CCMs), a common cause of stroke and epilepsy. Lesions are characterized by grossly dilated capillaries, associated with vascular leak and hemorrhage. The CCM occurs in sporadic or inherited (autosomal dominant) forms, the commonest cause of the latter is germline mutations in the *CCM1* (KRIT1) gene. Previous work has demonstrated that KRIT1 localizes to endothelial cell (EC)--cell junctions and loss of KRIT1 leads to junctional instability associated with activation of RhoA and its effector Rho kinase (ROCK). Our group and others have shown that blockade of ROCK restores the integrity of EC-cell junctions, and rescues background hyperpermeability in brain, lungs and skin of $Ccm1^{+/-}$ heterozygous animals, but there has not been to date any evidence of therapeutic effect on actual CCM lesions, the hallmark of the disease. We hypothesized that ROCK inhibition with fasudil would reduce CCM lesion genesis.

METHODS: Based on recent evidence of Knudsonian two-hit mutations in familial CCM lesions, we recently generated a model of CCM1 disease by promoting somatic mutation load in heterozygous mice ($Ccm1^{+/-}Msh2^{-/-}$). These mice develop a rich repertoire of lesions including single cavern (Stage 1) and multicavernous (Stage 2) CCM lesions, with high penetrance and low animal attrition. Lesions exhibit all known phenotypic and molecular signatures of human CCM. We treated these mice with ROCK inhibitor fasudil (100 mg/kg/day administered in drinking water from weaning to 5 months of age), or placebo, and blindly assessed CCM lesion burden using systematic survey of animals' brains.

RESULTS: Fasudil treated $Ccm1^{+/-}Msh2^{-/-}$ mice exhibited a significantly lower CCM lesion burden per brain as compared to placebo ($p = 0.01$), and the number of total caverns per brain was significantly reduced ($p = 0.00005$). The mean (± standard deviation) maximal diameter of Stage 2 CCM lesions was significantly smaller in the fasudil group (142 ± 0 µm vs. 425 ± 146 µm; $p = 0.03$), but not the size of individual caverns that comprise the lesions. Extravascular iron deposits, indicative of chronic hemorrhage, were present in 4 of the 12 lesions in 3 of the 4 placebo mice, and in none of the lesions in the fasudil group ($p=0.03$). Infiltration of immune cells (B cells and T cells) was present in the same lesions exhibiting iron deposits, in the placebo group, and in none of the lesions in the fasudil group ($p=0.03$). The mean (± standard deviation) EC proliferative index (ratio of Ki67 immunopositive EC/total number of ECs lining caverns in CCM lesions) was 7.2 ± 2.5 % in the placebo group, and remarkably 0 in the fasudil group (8/111 versus 0/59; Fisher's exact test $p= 0.05$). Mice treated with fasudil showed decreased pMLC staining in ECs lining CCM lesions (staining intensity regression coefficient = - 1.6670, $p= 0.000075$, common odds ratio= 0.189), indicating that fasudil inhibited ROCK activity within the lesion proper

CONCLUSIONS: Fasudil treated mice had a significantly decreased prevalence of CCM lesions compared to placebo controls. Lesions in treated animals were smaller and less likely associated with hemorrhage, inflammation and endothelial proliferation, and exhibited decreased expression of ROCK activation biomarker. These data represent the first report of therapeutic benefit in CCM disease, and indicate that ROCK activation is a critical step in CCM lesion genesis and maturation. We present a translational roadmap of relevant questions to be tested in animal models, and potential strategies for clinical trials in human CCM disease.

7:44-7:51 THE FAILURE OF PREOPERATIVE ETHYLENE-VINYL ALCOHOL COPOLYMER EMBOLIZATION TO IMPROVE OUTCOMES IN AVM MANAGEMENT: CASE SERIES

Professor Michael K. Morgan, MBBS, MMedEd MD (Syd), PhD (Honorary)(UKM), FRACS, GAICD, *Vice President, Health and Medical Development, Macquarie University, NSW, Australia*

BACKGROUND: Ethylene-vinyl alcohol copolymer embolization is increasingly utilized as a preoperative measure to assist the resection of brain AVM (bAVM). However, the economic impact and the risks of treatment need to be considered when evaluating the benefits that this method of embolization purports to bring to AVM management. In parallel with evolution of embolization practice, there have been changes to microsurgical practices to assist with intraoperative AVM bleeding including early "cone" isolation, selective dural inclusion in resection margins and selective "strip" craniectomy.

AIM: To compare the outcomes from surgery for bAVM in three consecutive periods of practice: during the first period when a policy of selective embolization was employed (prior to ethylene- vinyl alcohol copolymer); during the second period when a policy of selective embolization with ethylene-vinyl alcohol copolymer was employed but no patient with Spetzler-Martin 1 or 2 AVM was to be embolized; and during the last period when no embolization was employed.

METHOD: A consecutive case series between 1989 and July 2011 was retrospectively analyzed for the three periods. Adverse outcomes were considered to be surgical or endovascular complications leading to a new neurological deficit present at last follow-up examination resulting an outcome modified Rankin Score of >2. 95% confidence intervals were calculated with the modified Wald method. Comparisons were made with Chi^2 with Yates correction. Insight into changes in case selection that evolved during the course of this study were made by looking at those patients that were less than 50 years of age with Spetzler-Martin grades 4 and 5 bAVM that were not treated because of the surgeon's opinion of operative difficulty.

RESULTS: 580 consecutive surgical cases were analysed. The breakdown of the Spetzler-Martin Grade during the three periods were: 261 Grade <3, 135 Grade 3 and 49 Grade >3 during the first period (1989-Feb, 2005); 36 Grade <3, 37 Grade 3 and 20 Grade > 3 during the second period (Feb, 2005-Aug, 2008); 28 Grade <3, 8 Grade 3 and 6 Grade >3 during the third period (Aug, 2008-July, 2011). The series results are summarised in the table:

	Period 1: Embolization prior to ethylene-vinyl alcohol copolymer (cases)	Period 2: Embolization ethylene-vinyl alcohol copolymer (cases)	Period 3: No embolization (cases)	P value period 1 cf. period 2; and period 2 cf. 3
Grade <3 embolized	8% (21/261)	0% (0/36)	0% (0/28)	0.18
Grade 3 embolized	17% (23/135)	24% (9/37)	0% (0/8)	0.59
Grade >3 embolized	43% (21/49)	80% (16/20)	0% (0/6)	0.006
Grade <3 mRS >2	0.4% 95CI 0-2.4% (1/261)	0% 95CI 0-11.5% (0/36)	0% 95CI 0-14% (0/28)	0.35
Grade 3 mRS >2	5.2% 95CI 2.4-10.6% (7/134)	5.4% 95CI 0.6-16.6% (2/37)	0% 95CI 0-37% (0/8)	0.48
Grade >3 mRS >2	12.2% 95CI 5.4-24.6% (6/49)	35% 95CI 18-57% (7/20)	50% 95CI 19-81% (3/6)	0.03; 0.43
Grade >3 inoperable < 50 years of age	29% 95CI 20-41% (20/69)	23% 95CI 11-42% (6/26)	60% 95CI 36-80% (9/15)	0.38; 0.02
Grade 3 mRS >2 due to	0% (0/6)	0% (0/2)	NA	
Grade 3 mRS >2 due to	0% (0/6)	43% (3/7)	NA	0.12

CONCLUSIONS: Outcomes for Spetzler-Martin Grade 1 and 2 bAVMs have a 0.3% (95% CI 0-1.9%) risk of a new permanent neurological deficits with a mRS >2. These results will unlikely be improved by embolization. The introduction of ethylene-vinyl alcohol copolymer embolization as a precursor to surgery has failed to improve outcomes. The authors believe that decisions to resect AVM as opposed to conservative management should ignore the potential "beneficial" contribution of embolization in the management of bAVM.

7:51-7:58 MANAGEMENT OF PEDIATRIC INTRACRANIAL ARTERIOVENOUS MALFORMATION: EXPERIENCE WITH MULTIMODALITY THERAPY

Gary K. Steinberg, MD, PhD[1]; *Tim E. Darsaut, MD[1]; Raphael Guzman, MD[1]; Mary L. Marcellus, RN[2]; Michael S. Edwards, MD[1]; Lu Tian, PhD[3]; Huy M. Do, MD[2]; Steven D. Chang, MD[1]; Richard P. Levy, MD, PhD[4]; John R. Adler, MD[1]; Michael P. Marks, MD[2]*

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BACKGROUND: Successful management of pediatric arteriovenous malformations (AVMs) often requires a balanced application of embolization, surgery, and radiosurgery.

Objective: The authors describe their experience treating pediatric AVMs.

METHODS: We analyzed 120 pediatric (<18 years) AVMs treated with various combinations of radiosurgery, surgery, and endovascular techniques.

RESULTS: Between 1985-2009, 76 children with low Spetzler-Martin grade (I-III) and 44 with high-grade (IV-V) AVMs were treated. Annual risk of hemorrhage from presentation to initial treatment was 4.0%, decreasing to 3.2% after treatment initiation until confirmed obliteration. AVM obliteration results were available in 101 patients. Initial single-modality therapy led to AVM obliteration in 51/67 (76%) low-grade and 3/34 (9%) high-grade AVMs, improving to 58/67 (87%) and 9/34 (26%) respectively with further treatment. Mean time to obliteration was 1.8 years for low-grade and 6.4 years for high-grade AVMs. Disabling neurological complications occurred in 4/77 (5%) low-grade and 12/43 (28%) high-grade AVMs. At final clinical follow-up (mean 9.2 yrs), 48/67 (72%) with low-grade lesions had mRS 0-1, compared to 12/34 (35%) for high-grade AVMs. On multivariate analysis, significant risk factors for poor final clinical outcome (mRS $\geq$2) included baseline mRS $\geq$2 (OR 9.51 [95% CI: 3.31, 27.37] *P*<0.01), left-sided location (OR 3.03 [95% CI: 0.12, 0.90] *P*=0.04), and high AVM grade (OR 4.35 [95% CI: 1.28, 14.28] *P*=0.02).

CONCLUSIONS: Treatment of pediatric AVMs with multimodality therapy can substantially improve obliteration rates and may decrease AVM hemorrhage rates. The poor natural history and the risks of intervention must be carefully considered when deciding to treat high-grade pediatric AVMs.

7:58-8:05 MUTIMODALITY TREATMENT OF CONUS MEDULLARIS AVMS: TWO DECADES OF EXPERIENCE WITH COMBINED ENDOVASCULAR AND MICROSURGICAL TREATMENTS

David A. Wilson, MD, Adib A. Abla, MD, Timothy D. Uschold, MD, Cameron G. McDougall, MD, Felipe C. Albuquerque, MD, ***Robert F. Spetzler, MD***
Division of Neurological Surgery, Barrow Neurological Institute, St. Joseph's Hospital and Medical Center, Phoenix, AZ

INTRODUCTION: Conus medullaris arteriovenous malformations (AVMs) are rare and challenging spinal vascular lesions that cause progressive debilitating myeloradiculopathy. Only sporadic reports of conus AVMs have been published.

OBJECTIVE: To better define the presentation, prognosis, and optimal treatment of these lesions, we present the first case series of conus AVMs, reflecting over two decades of experience with a multimodality endovascular and surgical approach.

METHODS: We retrospectively reviewed the charts of 16 patients with a conus AVM treated at our institution from 1989 to 2010. For each patient, the following clinical data were collected: age, gender, symptoms, angiographic findings, type of treatment, complications, degree of angiographic obliteration, recurrence at follow-up, and need for re-treatment. Ambulatory status, Frankel grade, motor function, and bladder/bowel function were assessed before treatment, at discharge, and at last follow-up.

RESULTS: Eight (50%) patients underwent embolization followed by microsurgical resection, and eight (50%) underwent microsurgical resection only. The rate of complete angiographic obliteration was 88%. At last follow-up (mean 70 months), 43% of patients were neurologically improved, 43% were stable, and 14% were worse compared to before treatment. During follow-up, three recurrences were detected, including the only two instances of long-term neurological decline. In the absence of a recurrence, all patients ambulatory before treatment remained ambulatory at follow-up while 75% of the initially nonambulatory patients regained the ability to walk.

CONCLUSION: Although conus AVMs are challenging to treat, excellent long-term outcomes are possible with a multimodality approach. Recurrence is associated with long-term neurological decline and calls for close follow-up.

8:05-8:12 "SURGICAL" INTRACRANIAL DURAL ARTERIOVENOUS FISTULAS

***Roberto C. Heros, MD**, and Samy Elhammady, MD*
Department of Neurosurgery, University of Miami

INTRODUCTION/HYPOTHESIS: Nowadays, most intracranial dural arteriovenous fistulas (AVFs) are directly referred for endovascular therapy and surgical therapy is reserved for those cases that cannot be adequately treated endovascularly. From our experience and a review of the literature, we feel that there are some AVFs, particularly those located at the base of the falx in the anteromedial aspect of the anterior fossa ("ethmoidal") and those located along the superior petrosal sinus in the tentorium ("petrosal") that should be primarily treated surgically. AVFs in these locations have in common the fact that they are fed by arterial branches that are difficult and/or dangerous to access endovascularly and that thy drain through a single pial vein, or less commonly, two or more veins that can be easily accessed and occluded at surgery with cure of the fistula.

METHODOLOGY: The senior author's (RCH) experience with primary open surgical treatment of intracranial AVFs over the last 15 years, which includes 15 consecutive cases, was retrospectively reviewed.

RESULTS: The patient's range in age from 37 to 68 years and there were 9 males and 6 females. 5 presented with hemorrhage, 3 with headaches, 2 with imbalance and dizziness, 2 with a bruit and 3 were incidental. The location of the fistulas were as follows: 3 "ethmoidal", 6 "petrosal", 2 lateral wall of the cavernous sinus, I sphenoparietal sinus, I transverse sigmoid sinus, I superior of sagittal sinus and I torcula. All were treated primarily with open microsurgical occlusion of the draining vein(s) and in all but one (superior sagittal sinus with multiple fistulous points), the fistula was completely occluded. There were no immediate complications of surgery, but one patient died as a result of the presenting hemorrhage and another patient that was doing well clinically after surgery died from a massive thromboembolic complication during routine follow-up angiography.

Angiographic characteristics and surgical findings in fistulas in these different locations will be illustrated.

CONCLUSION: There are some intracranial dural AVFs that should be treated primarily with surgery without prior attempts at endovascular embolization. Generally, their common denominator characteristics include arterial feeders that are difficult and/or dangerous to embolize and cortical drainage, usually into a single cortical vein, that can be readily accessed with open microsurgery. AVFs located in the anteromedial frontal fossa at the base of the falx ("ethmoidal") and those located in the tentorium in the region of the superior petrosal sinus ("petrosal") generally have these characteristics and these patients do very well with primary open microsurgical occlusion of the draining vein(s). There are several other locations where AVFs with the above described characteristics can and frequently should be treated primarily with open microsurgery.

8:20-8:28 AUTOMATED DETECTION OF INTRACRANIAL ANEURYSMS USING WRITHE NUMBER ANALYSIS OF THE CEREBRAL VASCULATURE IN 3D SPACE

***Adel M. Malek, M.D., Ph.D.**, and Alexandra Lauric, Ph.D.*
Cerebrovascular and Endovascular Division, Department of Neurosurgery, Tufts Medical Center and Tufts University School of Medicine. Boston, MA 02111

INTRODUCTION/HYPOTHESIS: The detection of brain aneurysms plays a key role in reducing the incidence of intracranial subarachnoid hemorrhage (SAH) which carries a high rate of morbidity and mortality. Accurate detection using an automated algorithm has the potential to significantly decrease cases of misdiagnosed aneurysms on cross-sectional imaging such as magnetic resonance and computed tomographic angiography and could serve as both a diagnostic aid and as a data mining robot. Previous work in the field has relied on pattern recognition and the need for training sets.

METHODOLOGY: A novel computational scheme for automated detection of intracranial aneurysms is proposed in this study that is based on a 3-dimensional (3D) adaptation of the Writhe Number originally devised to describe twisting of two-dimensional sheets. We have adapted the Writhe Number for use on 2-dimensional surfaces, where it is of zero value on smooth paraboloid-fitted surfaces such as the normal branching cerebrovascular network, and non-zero at sites of abnormal dilatation. When applied to the segmented cerebral vasculature derived from cross-sectional imaging, the 3-D Writhe method detects aneurysms as suspect regions on the vascular tree, and is proposed to assist diagnosticians with their interpretations to help reduce missed detection events on CTA and MRA.

RESULTS: In the current approach, the cross-sectional imaging data are segmented and their medial axis is computed, leading to a skeletal branching network. Small regions along the vessels are inspected by the algorithm and the Writhe Number is introduced as a new surface descriptor to quantify how closely any given region approximates a tubular structure. Aneurysms are detected as non-tubular regions of the vascular tree. The geometric assumptions underlying the approach are investigated analytically and validated experimentally. The method was tested on 30 experimental cases (10 each) of 3D-rotational angiography (3D-RA), magnetic resonance angiography (MRA), and computed tomography angiography (CTA). In our experiments, 100% sensitivity was achieved with average false positives rates of 0.66 per study on 3D-RA data and 5.36 false positive rates per study on CTA data. Case studies will highlight the algorithm's ability to detect both berry-type sidewall and bifurcation as well as fusiform aneurysms.

CONCLUSIONS: The current novel algorithm based on adaptation of the Writhe Number in 3D space provides cerebral aneurysm detection performance that is superior to other available automated techniques because of its absence of training set requirement and excellent detection performance. The algorithm can serve as a precursor for shape-based aneurysm classification following detection for rupture risk assessment.

8:28-8:36 RELATIONSHIP OF GROWTH TO ANEURYSM RUPTURE IN ASYMPTOMATIC ANEURYSMS ≤ 7 MM: A SYSTEMATIC ANALYSIS OF THE LITERATURE

***Bendok BR**, Chmayssani M, Aoun SG, Batjer HH;*
Northwestern University Medical School, Chicago, IL

Introduction: The apparent paradox of natural history data suggesting low rupture risk of small asymptomatic aneurysms and the median size of aneurysm rupture remains unexplained. Aneurysm growth rates and their potential relationship with rupture risk have not been well examined in natural history studies.

OBJECTIVE: To examine the question of whether small asymptomatic aneurysms ≤ 7 mm that are followed up over time rupture, and to determine the relationship between aneurysm growth and aneurysmal rupture.

METHODS: We reviewed all publications on unruptured aneurysms published from 1966 to 2009. We then selected all aneurysms ≤ 7 mm for which measurements were reported for at least 2 time points and for which initial asymptomatic status and ultimate outcome (rupture vs. unruptured) were reported. Using the Mann-Whitney U test, we compared absolute diameter annual growth rate.

RESULTS: Our search retrieved 64 aneurysms. Thirty aneurysms ruptured during follow-up, of which 27 were enlarged before rupture (90%). Thirty-four aneurysms did not rupture, of which 24 enlarged during follow-up (71%). Absolute diameter growth was statistically larger for ruptured aneurysms compared to unruptured aneurysms (3.89 ± 2.34 vs. 1.79 ± 1.02 mm; $P < .001$ respectively). Annual growth rates for aneurysms in the two groups, however, were not statistically different (27.46 ± 18.76 vs. 32.00 ± 29.30; $P = .92$).

CONCLUSION: Small aneurysms are prone to growth and rupture. Aneurysm rupture is more likely to occur in aneurysms with larger absolute diameter growth, but rupture can also occur in the absence of growth. The annual growth rate in both groups suggests that the rate of growth of aneurysms is highly variable and unpredictable, justifying treatment or close diagnostic follow-up.

8:36-8:44 CORRELATION OF CHANGES IN INTRAOPERATIVE SOMATOSENSORY EVOKED POTENTIALS (SSEPs) DURING ANEURYSM SURGERY WITH POSTOPERATIVE STROKE RATES

Rafael J. Tamargo, MD, FACS*, Robert T. Wicks, BS, Gustavo Pradilla, MD, Shaan M. Raza, MD, Uri Hadelsberg, Alexander L. Coon, MD, and Judy Huang, MD*
Johns Hopkins Hospital

BACKGROUND:
Somatosensory evoked potential (SSEP) monitoring is used during intracranial aneurysm surgery to assess the potential ischemic injury associated with microsurgical or anesthetic manipulations.

OBJECTIVE:
We present the outcomes of 691 consecutive aneurysm cases (663 patients) treated microsurgically who underwent intraoperative SSEP monitoring, and analyze the sensitivity and specificity of transient (reversible) and permanent (irreversible) SSEP changes in predicting post-operative stroke.

METHODS:
Of 691 surgeries analyzed, 403 (391 anterior circulation, 12 posterior circulation) were for unruptured aneurysms and 288 (277 anterior circulation, 11 posterior circulation) were for ruptured aneurysms. Post-operatively, symptomatic patients underwent computerized tomography (CT) and/ or magnetic resonance (MR) imaging to establish the diagnosis of a new stroke. Positive predictive value (PPV), negative predictive value (NPV), sensitivity, and specificity were calculated with a Fisher's Exact Test (two-tailed P value).

RESULTS:
The overall stroke rate (including both minor and major strokes) for the entire cohort was 7.5% (52 of 691 cases). For unruptured aneurysm cases, the rate of both minor and major strokes was 6.7% (27 of 403 cases), and for ruptured cases the rate of both minor and major strokes was 8.9% (25 of 288 cases). Intraoperative SSEP changes occurred in 45 of 691 cases (6.5%), of which 16 of 403 (4.0%) occurred in unruptured aneurysms, and 29 of 288 (10%) in ruptured aneurysms. In unruptured aneurysm cases, reversible SSEP changes were associated with only a 20% stroke rate, but irreversible changes were associated with an 80% stroke rate. In ruptured aneurysm cases, however, reversible changes were associated with only a 12% stroke rate, and irreversible changes were associated with a 42% stroke rate. The overall accuracy of SSEP changes in predicting post-operative stroke was PPV=30%, NPV=94%, sensitivity=25%, and specificity=95%.

CONCLUSION:
Intraoperative SSEP changes are more reliable in unruptured aneurysm cases than in ruptured cases. Whereas irreversible SSEP changes- in unruptured cases were associated with an 80% stroke rate, similar SSEP changes in ruptured cases were associated with only a 42% stroke rate. This information is helpful during the intraoperative management of reported SSEP changes.

8:44-8:52 LANGUAGE AND COGNITIVE DISTURBANCES AFTER ANEURYSMAL SAH: THE IMPACT OF TREATMENT

Hildo R C Azevedo-Filho MD, PhD, FRCS (SN)
Recife, Brazil

Blood in the SAH space is responsible most of times for severe disturbances of brain functions. Nowadays, when analyzing post-operative results is no longer sufficient to gauge according to the Glasgow Outcome Scale (GOS) when good results are considered to be achieved when patients pass on the test 'walk and talk'.

Certainly, language and cognitive impairment represent a serious burden to patients (and relatives) who survive the whole procedure, including the treatment. However, due to clipping or coiling being performed within a few days after the bleeding, it is almost impossible to determine which phenomenon is the main cause of the disturbances, either the SAH or the treatment. On the other hand, it is essential to try to detect eventual differences between the two types of aneurysms' occlusion.

Unfortunately, as in most of our patients we cannot treat them on an early stage after the hemorrhage, we were able to perform several neuropsychological tests on the second week following the SAH and recheck them between eight and 14 days after the clipping or coiling.
Therefore, we compared the changes arising from the various aneurysms sites, before and after treatment. In the immediate post-operative screen there was a favorable trend towards coiling against clipping, which tended to equalize in the 3-month follow-up.

1 – Azevedo-Filho HRC et al.; Language and cognitive disturbances following aneurismal subarachnoid hemorrhage. In Essential Practice of Neurosurgery, Eds. Kalangu K and Kato Y, 2010
2 – Chan A, Ho S, Poon W; Neuropsychological sequelae of patients treated with microsurgical clipping or endovascular embolization for anterior communicating artery aneurysm. Eur Neurol. 2002, 47:37-44
3 – Hutter B, Gilsbach JM, Kreitschmann I; Quality of life and cognitive deficits after subarachnoid hemorrhage. Br J Neurosurg. 1995, 9:465–75
4 – Powell M, Kitchen N, Heslin J, Greenwood R; Psychosocial outcomes at three and nine months after good neurological recovery from aneurismal subarachnoid hemorrhage: predictors and prognosis. J Neurol Neurosurg Psychaitry. 2002, 72(6):772-81

8:56-9:04 LARGE AND DYSMORPHIC MCA ANEURYSMS: TANDEM CLIPPING AND INTERLOCKING CLIPPING TECHNIQUES

David Chalif, MD, *Chief, Neurovascular Neurosurgery, North Shore University Hospital*
Assistant Professor, Department of Neurosurgery, Hofstra North Shore-LIJ Health School of Medicine

Large, multi-lobulated and dysmorphic aneurysms arising at the MCA bifurcation present a microsurgical challenge for complete obliteration and adequate preservation of distal M2 vessels.

These lesions frequently have no discrete neck and may incorporate M2 vessels into the base and proximal aspect of the aneurysm. Additionally, the axis of projection of the individual lobes of multi-lobulated aneurysms may project up to 180 degrees away from each other. Effective and complete microsurgical clipping can be achieved successfully with an orthogonal interlocking tandem clipping technique.

1325 aneurysms were treated by direct microsurgical clipping over a 26 year period by a single surgeon. Out of this series, 380 were at the MCA bifurcation. A sub-set of 21 of these cases was treated with a microsurgical tandem interlocking clip technique. The majority of these cases were unruptured aneurysms. This reconstruction strategy employed one or more fenestrated clips interlocking with and incorporating the blade(s) of the primary straight or curved clip(s). Fenestrated clips used typically have wide fenestrations and short blades. Temporary proximal arterial occlusion was routine. Intra-operative ICG angiography and post-operative angiography demonstrated complete obliteration in all cases.

All patients had excellent neurologic outcomes. In the era of advances in endovascular technique--inclusive of stent-assisted coiling--large, dysmorphic and complex MCA aneurysms clearly remain in the realm of microsurgical treatment. Excellent anatomic and clinical outcomes can be achieved with this microsurgical strategy.

9:04-9:12 GIANT CEREBRAL ANEURYSMS: OPERATIVE NUANCES AND OUTCOME

***Anil Nanda MD**, FACS, Vijayakumar Javalkar MD*
Department of Neurosurgery, Louisiana State University Health Sciences Center, Shreveport, LA

The usual management goals of giant intracranial aneurysms are to prevent rupture/re-rupture, to reduce mass-effect, and to ensure parent vessel patency. To achieve these goals, neurosurgeons face a wide spectrum of challenges: complex aneurismal anatomy (wide neck, calcification, intra-nidal thrombosis), severely diseased parent vessel, perforators emanating from within aneurysm sac, anatomically complex sites of aneurysm development. The various modalities of treating these aneurysms are: surgical clipping, endovascular coiling and/or stenting, vascular bypass (primary or adjunct), proximal parent vessel occlusion (Hunterian ligation)

The case records of 48 consecutive giant intracranial aneurysm patients (from 1990 to 2009), operated by the senior author (AN), were retrospectively reviewed to evaluate the indications, complications and operative outcomes at the latest follow-up. Over this period we could identify 48 patients with giant intracranial aneurysms.

The mean age in our series was 51 years (range: 29-73 years). There was a female preponderance (male: female ratio = 2.2: 1. Sudden onset headache was the most common form of presentation (68.8%), followed by cranial nerve deficits (29.2%) and seizures (10.4%). At admission, majority of the patients were in grade I and II. Sub-arachnoid hemorrhage was seen in two-thirds of the patients in admission CT-head. Ophthalmic segment ICA aneurysms were the commonest in occurrence (41.7%), followed by MCA aneurysms (14.6%) and A-Comm. artery aneurysms (10.4%) . Multiple aneurysms were noted in 18.75% of cases. Majority of the patients underwent pterional approach (70.8%), followed by orbito-zygomatic approach (18.8%) and far-lateral approach (6.3%). A skull-base approach was needed in 75% of patients. Intraoperative complications were noted in 8.3% of cases. One patient suffered an ICA compromise which was circumvented by a saphenous graft. Two other patients suffered carotid tears which underwent direct repairs. Another patient developed M1 segment spasm and was successfully managed conservatively. Post-operative complications were noted in 15 patients (31.2%). Of these, motor weakness was noted as the commonest complication (7 patients), majority of which were transient. Clinical outcome was assessed in terms of Glasgow Outcome Score. Majority of patients (62.5%) experienced excellent outcome (GOS 5) at the latest follow-up.

In properly selected patients, surgical clipping of giant intracranial aneurysms is an acceptable mode of treatment, with long-term favorable outcomes in most cases. It ensures complete aneurysm occlusion as well as parent vessel patency in overwhelming majority.

9:12-9:20 GIANT INTRACRANIAL ANEURYSMS: EVOLUTION OF MANAGEMENT IN A CONTEMORARY SERIES

Michael T. Lawton, MD *,Department of Neurological Surgery, University of California San Francisco, San Francisco, CA*

OBJECTIVE: A contemporary surgical experience with giant aneurysms is presented to examine changes in management relative to earlier reports, to establish the role of open microsurgery in the management strategy, and to quantify results for comparison with evolving endovascular therapies.

METHODS: During a 13-year period, 140 patients with 141 giant aneurysms were treated surgically. 100 aneurysms (71%) were located in the anterior circulation, and 41 aneurysms were located in the posterior circulation.

RESULTS: Excluding 3 patients with calcified aneurysms that were coiled after unsuccessful clipping attempts, 108 aneurysms (78%) were completely occluded, 14 aneurysms (10%) had minimal residual aneurysm, and 16 aneurysms (12%) were incompletely occluded with reversed or diminished flow. 18 patients died in the perioperative period (surgical mortality, 13%). Bypass-related complications resulted from bypass occlusion (7 patients), aneurysm hemorrhage due to incomplete aneurysm occlusion (4 patients), or aneurysm thrombosis with perforator or branch artery occlusion (4 patients).

13 patients were worse at late follow-up (permanent neurological morbidity, 9%; mean length of follow-up, 23±1.9 months). Overall, good outcomes (GOS 5 or 4) were observed in

114 patients (81%) and 109 patients (78%) were improved or unchanged after therapy.

CONCLUSIONS: Direct clipping remains the preferred surgical technique for giant aneurysm occlusion. A heavy reliance on bypass techniques distinguishes this contemporary surgical experience from earlier ones, and obviates the need for hypothermic circulatory arrest. These results are superior to current endovascular results, indicating that microsurgery should remain the treatment of choice for giant aneurysms.

9:25-9:33 FUSION OF INTRAOPERATIVE 3-DIMENSIONAL ROTATIONAL ANGIOGRAPHY AND FLAT-PANEL DETECTOR COMPUTED TOMOGRAPHY FOR CEREBROVASCULAR NEURONAVIGATION

*Lewis Z Leng MD (Weill Cornell Medical College / NYP), David G Rubin MD Weill Cornell Medical College / NYP) and **Howard A Riina MD** (New York University School of Medicine / NYU Langone Medical Center)*

OBJECTIVE: We introduce a technique utilizing intraoperative flat-panel detector computed tomography (FD-CT) and 3-dimensional rotational angiography (3D-RA) acquired in the hybrid operative suite to provide full neuronavigation capabilities during cerebrovascular surgery without the use of preoperative imaging studies.

METHODS: An Artis Zeego FD system (Siemens AG, Forchheim, Germany), mounted on a robotic C-arm was used during the clipping of an aneurysm to acquire intraoperative FD-CT and 3D-RA images. These images were then fused using BrainLab iPlan 3.0 software and sent to a Vector Vision Sky neuronavigation system (NNS) (BrainLAB, Heimstetten, Germany) to provide intraoperative image guidance.

RESULTS: The use of intraoperative FD-CT and 3D-RA with a NNS allowed for accurate visualization of the vascular anatomy and localization of pathology. In a case of a patient harboring two aneurysms, one that was surgically clipped and a second that was treated endovascularly, the 3D-RA clearly showed neck remnants at both aneurysms. Use of the NNS assisted in further clip placement for obliteration of these neck remnants.

CONCLUSION: Hybrid operating suites equipped with FD-CT, 3D-RA and NNS capabilities can be used to provide intraoperative 3D image guidance during cerebrovascular surgery with excellent accuracy and without the need for preoperative angiography. Furthermore, this technique required less than 15 minutes for image acquisition and utilizes digitally subtracted angiographic images that are superior to conventional CT or MRI for the imaging of cerebrovascular pathology.

9:33-9:41 ENDOVASCULAR TREATMENT OF FUSIFORM POSTERIOR CIRCULATION ANEURYSMS: A DECADE OF EVOLUTION

Ricardo A Hanel, MD PhD *, Associate Professor of Neurosurgery, Mayo Clinic, Jacksonville, FL*

INTRODUCTION: The use of intracranial stents for endoluminal reconstruction of the parent vessel for posterior circulation fusiform aneurysms has evolved as an appealing concept. Recent advances on access and stent technology have collaborated to improve the idea. We report a single center experience on the treatment fusiform posterior circulation aneurysms using modern access and stent technology.

METHODS: This is a retrospective analysis of all fusiform posterior circulation lesions (acute dissections excluded) seen at single academic institution gathered from prospective collected series of 511 aneurysms treated by the author from July 2007 to June 2011. Immediate angiographic results, endovascular strategies, procedure-related complications, clinical outcomes, follow up images were assessed.

RESULTS: 9 (5 female) patients with symptomatic, posterior circulation fusiform aneurysms were identified. 8 patients underwent endovascular treatment. Two patients were treated with carotid stents (Precise Rx , Johnson and Johnson; Wallstent, Boston Scientific); 4 patients with telescoping aneurysm stents (Enterprise Stent, Johnson and Johnson) and two using flow diverters (Leo + Silk – Balt). 88% success-rate was obtained. One patient suffered a fatal subarachnoid hemorrhage after VP shunt, prior to any endovascular treatment. Periprocedural complications occurred in 25% of the cases (2 ischemic events, one distal PCA infarct, one pontine infarct). Symptoms were improved in 50% of the cases.

CONCLUSIONS: The use of Self-expanding stents for the treatment of posterior circulation fusiform aneurysms is evolving. The use of devices, specifically designed for the intracranial circulation, will likely lead to improved results. Further experience is needed to assess the pitfalls of lower porosity stents on the vertebrobasilar artery.

9:45-9:53 PIPELINE EMBOLIZATION OF PARACLINOID ANEURYSMS: EXPERIENCE WITH 34 CASES

***Giuseppe Lanzino, M.D.**, Department of Neurologic surgery, Mayo Clinic, Rochester, MN*

The Pipeline embolization device (PED) has been approved by the FDA for the treatment of complex paraclinoid aneurysms. We review our experience with 34 cases treated over the past two years.

From June 2009 until June 2011, 33 patients with 34 paraclinoid aneurysms were treated with the PED. There were 30 women and 3 men with a mean age of 54 years (range 24 to 74). Most of the aneurysms were large or giant and all had a wide neck. Nine aneurysms had been treated with previous coiling, while the remaining 24 had not had any previous treatment. Technical failure occurred in one patient in the very early phase of the experience with inability to navigate the device across the target segment. This patient, who had a recurrence after previous coiling, was treated with additional coil embolization.

Almost all of the patients experienced some degree of headache/local pain which reached a peak 5-7 days after the procedure and subsided within two weeks. Periprocedural complications consisted of transient confusion (1 patient), transient worsening of third nerve paresis (one patient), iatrogenic carotido-cavernous fistula due to wire perforation of the ICA (one patient), and a femoral access hematoma requiring surgical evacuation and direct suture-repair of the femoral artery. Delayed complications included GI bleed requiring hospitalization (one patient), epistaxys (one patient), and asymptomatic ICA occlusion diagnosed on follow-up angiography (one patient).

Follow-up angiography was available for 26 aneurysms at 6 months and 15 aneurysms at one year. Rates of complete occlusion were 65% at 6 months and 93% at one year. No patient was lost to follow-up. No transient or permanent neurological deficits were observed during clinical follow-up.

We conclude that Pipeline embolization is a valid strategy for the treatment of complex paraclinoid aneurysms with high rates of complete occlusion at follow-up and acceptable complication rates.

FRIDAY, OCTOBER 21

9:53-10:01 FLOW DIVERSION DEVICES FOR ANEURYSMS: READY FOR PRIME TIME? HECK NO!

Jacques Morcos, MD, FRCS*, Department of Neurosurgery, University of Miami*

Pipeline, the latest iteration of Flow Diversion Devices (FDD), has just been approved for use by the FDA in the US, in the treatment of aneurysms. FDD represent an extension of the concept of stenting aneurysm-bearing arterial segments, that are (or should be) not amenable to simple clipping. While the basic in vitro and animal research underlying the advances in flow diversion technology is robust and promising, the human applications have raised more than anecdotal concerns.

I reviewed all available published literature on the use of stent-assisted coiling, as well as the use of FDD in humans, from case reports to clinical trials, including both the SILK and PIPELINE devices. Particular emphasis was given to the following criteria of interest: feasibility, safety, efficacy and durability. I divide the presentation into: the science, the technology, the experience, the lessons and the "verdict".

The synthesis of the literature will clearly show that there was indeed great preliminary optimism with respect to the use of FDD. However the basis for general use is very weak, prone to overuse, and potentially dangerous. Following FDD placement, there are numerous examples of unexpected delayed and seemingly "unexplained" ruptures of previously unruptured aneurysms, as well as delayed parent artery occlusions. The clinical trials conducted often included aneurysms that did not satisfy the initial inclusion and exclusion criteria. Additionally, the question of durability is unanswered, since the most robust available single arm clinical trial is based on a median follow-up of 6 months only.

As not infrequently seen in the practice of medicine, technological advances often precede and supersede conceptual maturations. The use of FDD may well be another such example. At this time, there are too many unknown factors involved in the therapeutic stepwise thrombosis and healing of aneurysms, that "unexpected" complications are all too frequent. The author is concerned that, unless the use of FDD is limited to cases that are truly not reasonable candidates for clipping or bypass, abuse will set in, powered by the influence of industry, with an unacceptably high complication rate.

10:21-10:36 LUMBAR SPINAL FUSION REDUCES RISK OF RE-OPERATION AFTER LAMINECTOMY FOR LUMBAR SPINAL STENOSIS WITH GRADE I DEGENERATIVE SPONDYLOLISTHESIS: THE SLIP TRIAL AND NEUROPOINT SHERIFF'S DEPARTMENT

Zoher Ghogawala, MD, *Edward C. Benzel, MD, William E. Butler, MD, Subu N. Magge, MD, Jean-Valery CE Coumans, MD, J Fred Harrington, MD, Volker K.H. Sonntag, MD, and Fred G. Barker, MD*

OBJECTIVE: To compare laminectomy with fusion to laminectomy alone in terms of re-operation rates after surgery for lumbar spinal stenosis with grade I spondylolisthesis.

METHODS: A prospective, 5-center randomized clinical trial was conducted from 2002-2009. Patients aged 50-80 with degenerative spondylolisthesis (3-14 mm) with symptomatic lumbar spinal stenosis were eligible. Patients with mechanical instability or gross motion (> 3mm) on flexion-extension lumbar radiographs were excluded. Patients were randomized to either laminectomy alone or laminectomy with posterolateral instrumented fusion with autograft. Follow-up outcome assessments were done in the clinic at 1 month, 3 months, 6 months, 12 months, and then annually for 5 years by phone from an independent study coordinator. All re-operations in the lumbar spine were recorded.

RESULTS: 130 patients were screened, 106 were enrolled, and 66 randomized to receive either lumbar decompression alone versus lumbar decompression with posterolateral instrumented fusion with autograft. Mean age was 66.8 years. Two-year follow-up rate is 86%. Average follow-up is currently 44.8 months. For patients treated with laminectomy alone, the re-operation rate was 12/34 (35.3%). When fusion was added to laminectomy, the re-operation rate was considerably lower 4/31 (12.9%) (P=0.04). Actuarial rate of re-operation for both cohorts is depicted in Figure 1. All re-operations in the laminectomy cohort consisted of fusion performed at the index level for instability. Re-operations in the fusion cohort were at an adjacent level in all cases. Mean SF-36 and Oswestry (ODI) scores were substantially worse at 1 year in patients who ultimately underwent re-operation. Overall 2 and 4-year quality of life (SF-36) outcomes for both cohorts will be presented.

CONCLUSIONS: Performing a lumbar fusion when decompressing the spine in the context of a degenerative grade I spondylolisthesis significantly reduces the risk of re-operation within 4 years of the initial procedure.

10:36-10:51 NATIONAL NEUROSURGERY QUALITY AND OUTCOMES DATABASE (N^2QOD): A REVIEW OF CHALLENGES AND STRATEGIES RELEVANT TO SUCCESSFUL IMPLEMENTATION OF A NATIONAL CLINICAL REGISTRY

Anthony Asher, MD, FACS *(Carolina Neurosurgery and Spine Associates, Carolinas Medical Center), Mathew McGirt, MD (Vanderbilt University Department of Neurosurgery), Paul McCormick, MD, FACS (Columbia University Department of Neurosurgery)*

INTRODUCTION: The recent passage of the Patient Protection and Affordable Care Act (PPACA) has dramatically shifted the focus of all stakeholders in the medical system towards critical analyses of quality and cost in healthcare delivery. In this environment, clinical data registries have emerged as a useful and logical mechanism to develop high quality data related to the safety and value of specific therapeutic interventions. Unfortunately, while many healthcare providers have embraced the intention of reforms designed to improve the quality and value of care, variable interpretation of current federal regulations (particularly the Privacy and Common Rules) by various institutional review boards (IRBs) has created significant impediments to accomplishing these goals, particularly with respect to clinical registries.

METHODS: The American Association of Neurological Surgeons (AANS) shares with the public a sense of urgency and responsibility to meet the challenges of creating a sustainable healthcare system. Our organization has therefore developed, in conjunction with relevant national stakeholders, The National Neurosurgery Quality and Outcomes Database (N^2QOD). The primary purpose and design of this registry is provide practice groups and hospitals immediate infrastructure for analyzing and reporting the quality of their neurosurgical care (relative to risk-adjusted specialty-wide benchmarks) through a secure, national data collection network. Although the authors acknowledge the potential to use mature repositories of clinical data to advance the science of care (e.g., through retrospective analysis of data subgroups) the database is not primarily intended to produce "generalizable knowledge". As such, and based on our interpretations of the Privacy and Common Rules, we believe that this effort is wholly consistent with Quality Assessment and Improvement (QI) as described in 45 CFR, and therefore should not be designated as a research instrument.

RESULTS: Presently, 35 large national centers are presenting the N^2QOD Project Description for their IRBs under a "waiver of review" application. To date, 8 sites have received "IRB exempt" designations. Interestingly, clinicians at 5 additional sites have received "research" designations for N^2QOD and have been instructed to submit "protocols" and other materials to their IRBs for formal review. The end result of these "research" determinations will unquestionably involve a requirement for some type of informed consent process. In light of inconsistent local IRB evaluations of this registry project, and given the significant implications of variable interpretation of federal patient protection and research guidelines to the practical implementation of clinical registries, we have reached out to federal regulatory agencies (OHRP (HHS), FDA) and private advisory groups (The Brookings Institution) for instruction and guidance. Regional logic for research designations, government/private comment on N^2QOD and the implications of QI versus research determinations for clinical registries will be discussed by the authors, along with a general review of other challenges related to the development of a relevant and practicable national clinical registry program.

CONCLUSIONS: Because the standards surrounding research and the protection of human subjects are more developed and specific than those for quality improvement, the latter efforts are often subject to research standards in an effort to ensure the protection of patients. As clinical registries rely on serial evaluation of patient outcomes, the designation of such efforts as "research" (and, in particular, the requirement for formal informed consent) carries with it the potential of undermining quality efforts and compromising the validity of data assessments. The ultimate resolution of issues that relate to the intersection between quality improvement and true research will have profound implications for the successful implementation of clinical registries such as the N^2QOD and other Quality Care initiatives. The AANS is attempting to lead a national discourse on this critically important topic.

7:30-7:38 MANAGEMENT OF ACUTE CERVICAL SPINE AND SPINAL CORD INJURY: THE NEW GUIDELINES

Mark N. Hadley, MD, FACS*, Beverly C. Walters, MD, MSc, FRCSC, FACS, Bizhan Aarabi, MD, Sanjay S. Dhall, MD. Daniel E. Gelb, MD, R. John Hurlbert, MD, PhD, FRCSC, FACS, Curtis J. Rozzelle, MD, Timothy C. Ryken, MD, MS, FACS, Nicholas Theodore, MD, FACS*

The Joint Section on Disorders of the Spine and Peripheral Nerves

The Joint Section on Disorders of the Spine and Peripheral Nerves is pleased to announce the completion of a contemporary update of the medical evidence-based ***Guidelines for the Management of Acute Cervical Spine and Spinal Cord Injuries*****.** Originally produced and published in 2002, the guidelines author group has completely rewritten them, relying on contemporary medical evidence produced since the original publication. Several original topic areas were combined: Radiographic Assessment (asymptomatic and symptomatic) and ICU Management and Blood Pressure Management. Two new topics were added: Cervical Spine Injury Classification Systems and Electrophysiological Monitoring, resulting in 22 topic-specific chapters. Recommendations based on the strength of the medical evidence for each topic will be highlighted.

7:38-7:46 ASSESSMENT OF THECAL SAC DECOMPRESSION FOLLOWING LUMBAR DECOMPRESSION: MINIMALLY INVASIVE VERSUS OPEN APPROACHES

Richard G. Fessler, MD, PhD

INTRODUCTION: To evaluate the change in thecal sac cross-sectional area (CSA) following surgical treatment for lumbar stenosis and to compare these changes between minimally invasive and standard open approaches. It is hypothesized that the microendoscopic decompression of stenosis (MEDS) technique will achieve decompression of the thecal sac that is similar to that achieved during an open procedure.

METHODS: A retrospective blinded analysis was designed to quantitatively determine the amount of thecal sac decompression that was achieved during laminectomy using either the standard midline approach or the minimally invasive endoscopic approach. 18 patients underwent one-level posterior decompression for lumbar stenosis, (9 open, 9 MEDS). Lumbar MRI was obtained prior to surgery and following surgery (open approach average 16.3 months; MEDS average 16.6 months). CSAs of the thecal sac were averaged over the distance of the surgical site.

RESULTS: The mean ages of patients treated with the open and MEDS approaches were 55.2 and 66.4 years, respectively (p=0.07). Preoperative thecal sac CSA was 1.3cm (SD=0.36; range: 0.92-2.0) in patients treated with the open approach and 1.1cm (SD=0.26; range: 0.75-1.6) in patients treated with MEDS (p=0.07). Following the open approach thecal sac area increased by an average of 38% (p=0.009) similarly, the MEDS approach resulted in a 36% increase in CSA (p=0.02). Comparing the increase in thecal sac CSA following the open and MEDS approach, no significant difference in thecal sac CSA was found (p=0.82), where the open approach increased by 41.2% (SD=27.5; range: 8.1-95.6) and the MEDS approach increased by 38.4% (SD=22.9; range: 10.3-90.2).

DISCUSSION: Compared with the open approach for lumbar stenosis, the MEDS approach did not result in a statistically significant change in thecal sac decompression. Previous reports have documented negative effects of inadequate decompression of the spinal canal, including weakness, disability, and pain.

CONCLUSION: Collectively, these data suggest that the MEDS approach for lumbar decompression achieves statistically similar decompression of the thecal sac when compared to the open approach.

7:46-7:54 IMPACT OF PATIENT AGE ON COMPLICATION RATES AND TW0-YEAR CLINICAL OUTCOME FOLLOWING SURGICAL TREATMENT FOR ADULT SCOLIOISIS

Justin S. Smith, MD, PhD, *Christopher I. Shaffrey, MD, FACS*
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INTRODUCTION: The prevalence of adult scoliosis increases with age and has been suggested to be as high as 68% among the elderly. As medical advances continue to extend life expectancy and the demographics of the population expand the numbers of elderly to unprecedented levels, the impact of adult scoliosis will continue to increase. The finding of scoliosis in many adults is simply incidental and requires only education and follow-up, but for others, it can produce substantial pain and disability, leading many to seek surgical treatment. We hypothesized that elderly patients undergoing scoliosis surgery would have improvement in outcome measures that is at least comparable to younger patients, despite what we presumed would be greater complication rates among the elderly.

METHODS: This is a retrospective review of a prospective multicenter spinal deformity database. At baseline and regular follow-up intervals, patients completed the Oswestry Disability Index (ODI), SF-12 (a general measure of health-related quality of life), Scoliosis Research Society-22 (SRS-22, a scoliosis-specific measure of quality of life), and numerical rating scale (NRS; 0-10) for back and leg pain. Inclusion criteria included: age 25-85, scoliosis (Cobb angle $\geq$30 degrees), plan for scoliosis surgery, and 2-year follow-up.

RESULTS: Over a 5-year period, 206 of 453 patients (45%) completed 2-year follow-up, distributed among age groups as follows: 25-44 (n=47), 45-64 (n=121), and 65-85 (n=38). Perioperative complication rates were greater among older patients, with minor complication rates of 11%, 27% and 42% (P=0.004) and major complication rates of 6%, 15% and 29% (P=0.02) among patients aged 25-44, 45-64 and 65-85 years, respectively. No deaths were reported in this series. At baseline older patients had greater disability (ODI, P=0.001), worse health status (SF12-PCS, P<0.001), and more severe back pain (P=0.04), and leg pain (P=0.01). Mean SRS-22 did not differ significantly at baseline based on age. Within each age group, at 2-year follow-up there were significant improvements in ODI ($P \leq 0.004$), SRS-22 ($P \leq 0.001$), back pain (P<0.001), and leg pain (P<0.001). SF-12PCS did not improve significantly for patients 25-44 years old but did among those 45-64 (P<0.001) and 65-85 years old (P=0.001). Improvement in ODI was significantly greater among older patients (mean change, 25-44: -7; 45-64: -13; 65-85: -19, P=0.003), and there were trends for greater improvement in SF-12PCS (P=0.08) and SRS-22 (P=0.047) among older patients.

CONCLUSION: Elderly patients with scoliosis electing for surgical treatment have significantly greater disability and worse health status compared with younger patients. Despite increased complications, elderly patients undergoing scoliosis surgery had improvements in disability and health status that are at least comparable to younger patients.

7:54-8:02 LONG-TERM OUTCOMES OF LUMBAR FUSION AMONG WORKERS' COMPENSATION SUBJECTS: AN HISTORICAL COHORT STUDY

Trang H. Nguyen, MD, PhD, David C. Randolph, MD, MPH,* James Talmage, MD,† Paul Succop, PhD,* and* ***Russell Travis, MD‡***
*From the *Division of Epidemiology and Biostatistics, Department of Environmental Health, University of Cincinnati College of Medicine, Milford, OH; †Meharry Medical College,Nashville, TN; and ‡Department of Physical Medicine and Rehabilitation, University of Kentucky College of Medicine, Lexington, KY.*

INTRODUCTION: Historical cohort study. **Specific Aims.** To determine objective outcomes of return to work status (RTW), permanent disability status, post surgical complications, opiate utilization, and re-operation status for chronic low back pain subjects with lumbar fusion. Similarly, RTW status, permanent disability, and opiate utilization were also measured for controls.

METHODS: 725 lumbar fusion cases were compared to 725 non-surgical controls that were randomly selected from a pool of WC subjects with chronic low back pain (CLBP) diagnoses with dates of injury between 01/01/1999 and 12/31/2001. The study ended on 01/31/06. Main outcomes were reported as RTW status two years after the date of injury (for controls) or two years after date of surgery (for cases). Disability, re-operations, post-surgical complications, opioid usage, and deaths were also determined.

RESULTS: Two years after fusion surgery, 26% (n=188) of fusion cases had RTW, while sixty-seven percent (n=483) of non-surgical controls had RTW (p=<.001) within 2 years from the date of injury. The re-operation rate was 27% (n=194) for surgical patients. Thirty six percent (n=264) of the lumbar fusion subjects had complications. Permanent disability rates were 11% (n=82) for cases and 2% (n=11) for non-operative controls (p=<.001). Seventeen surgical patients and 11 controls died by the end of the study (p=0.26). For lumbar fusion subjects, daily opioid use increased 41% after surgery, with 76% (n=550) of cases continuing opioid use after surgery. cases continuing opioid use after surgery. Total number of days off work was more prolonged for cases compared to non-surgical controls, 1,140 days and 316 days respectively (p<.001). Final multivariate logistic regression analysis indicated the number of days off prior to surgery OR, 0.94(95% CI, 0.92-0.97), legal representation OR, 3.43(95% CI, 1.58-7.41), daily morphine usage OR, 0.83(95% CI, 0.71-0.98), re-operation OR, 0.42(95% CI, 0.26-0.69) and complications OR, 0.25(95% CI, 0.07-0.90) are significant predictors of RTW for lumbar fusion patients. Interestingly the surgical approach/procedure was not a significant factor in RTW status.

CONCLUSION: Lumbar fusion for the diagnoses of disc degeneration, disc herniation and/or radiculopathy in a WC setting is associated with significant increase in disability, opiate use, prolonged work loss, and poor RTW status. Results of the other studies on lumbar fusion in the WC population with similar poor results will be briefly reviewed, and compared to our study. See below.

Franklin, Gary M., et. al., "Outcome of Lumbar Fusion in Washington State Workers Compensation." Spine, 19; 17:1897-1904, 1994.
Carreon Leah Y., et al., "Clinical Outcomes after Posterolateral Lumbar Fusion in Workers' Compensation Patients." Spine Volume 35, No. 19, pp. 1812-1817,2010.
Maghout-Jurati, S., et al., "Lumbar Fusion in Washington State Workers' Compensation." Spine Vol. 31, No. 23, pp. 2715-2723, 2006,
DeBerard M. S., et al., Outcomes of Posterolateral Fusion in Utah Patients Receiving Workers' Compensation, Spine, 2001; 26(7):738-47.

8:02-8:10 EXOGENOUS CROSSLINK THERAPY: NEW HOPE FOR DISC DEGENERATION

***Phillip A. Tibbs, MD**, Chair, Department of Neurosurgery, University of Kentucky;*
Thomas Hedman, PhD, Research Faculty, Center for Biomedical Engineering. University of Kentucky

INTRODUCTION:

Disc degeneration is a major cause of pain, disability, surgery, and loss of work time in our society costing billions of dollars each year. Present treatment techniques deal with the end-stage of the degenerative cascade. The pathophysiology of the disc degeneration cascade includes loss of collagen matrix crosslinking which, combined with disc dehydration and mechanical stress cause loss of function and integrity of the disc. In our laboratories, we have used Genipin, a crosslinking reagent to augment and restore crosslinking in natural collagen matrix. We present a series of experiments in which we analyze the cytochemical and biomechanical effects of Genipin therapy in degenerated intervertebral discs. Preservation of disc integrity restores the unique biochemical composition and structure of the intervertebral disc, allowing it to support load, permit rotation and dissipate energy.

MATERIALS AND METHODS:

In four separate experiments, Genipin was injected into bovine and human degenerative intervertebral disc in vitro. Cytochemical evaluation of net fluid and nutrient inflow and outflow were performed. Net fluid inflow into treated specimens of nucleus pulposus increased 103%. Biomechanical evaluation with variable loading indicated improved mechanical instability and fatigue resistance as well as resistance to tear in Genipin-treated disc versus buffered saline-injected controls.

CONCLUSION:

These experiments indicate Genipin crosslinking improves collagen matrix permeability and proteoglycan retention. Hydration levels and fluid inflow and outflow in the intervertebral disc are enhanced. This in turn optimizes tissue permeability, nutritional reflow and waste product outflow. Exogenous crosslink therapy is a promising approach to retard progression of symptomatic disc degeneration in populations at risk. Controlled clinical trials are needed and planned.

8:10-8:18 A PROSPECTIVE ANALYSIS OF INCIDENTAL DUROTOMY DURING SPINAL SURGERY—3000 CASES PERFORMED IN AN ACADEMIC INSTITUTION

Paul J. McMahon, BA, ***Allan D. Levi, MD, Ph.D****, University of Miami*

INTRODUCTION: Incidental durotomy (ID) is an unfortunate but anticipated potential complication of spinal surgery. The incidence, contributing factors and the long-term effects of ID are not clearly understood.

METHODS: We conducted a prospective review of elective spinal surgery from a single surgeon over a 15 year period. Any spinal surgery involving peripheral nerve only, intradural procedure or dural tears due to trauma were excluded. The incidence was categorized by surgery type including primary or revision surgery, minimally invasive surgery, instrumented spinal fusion, etc…. Incidence was also examined in the context of neurosurgical training. Furthermore, the incidence and type of sequelae was examined for those patients experiencing an ID.

RESULTS: Out of an overall total of 2983 elective spinal surgery cases, 3.5% (103) experienced an ID. The incidence of ID (3.4%) during minimally invasive procedures was similar but no patients experienced a delayed CSF leak. The incidence during revision surgery was higher (6.3%) and had a higher incidence (3x) of delayed complications including cerebrospinal fluid (CSF) leak. There was marked difference in incidence between cervical (1.31%) and thoracolumbar (5.09%) cases. The incidence was lower for cases involving spinal instrumentation (2.4%). When physician training was examined, residents accounted for 48% of all IDs, while fellows accounted for 27% and the attending 25%. Of all the cases that involved an ID, 7.8% of patients experienced a neurologic deficit and 7% presented with symptoms due to a delayed CSF leak requiring operative repair.

CONCLUSION: We established a baseline incidence for durotomy after spine surgery including procedure type, clarified contributing factors and examined the potential effects of ID on patient outcomes and the need for revision surgery for CSF leak.
Incidental durotomy (ID) is an unfortunate but anticipated potential complication of spinal surgery. The incidence, contributing factors and the long-term effects of ID are not clearly understood.

8:30-8:38 DEVELOPMENT AND INITIAL USE OF A NEW PLATFORM FOR WRITING, REVIEW, PUBLICATION ANDUSE OF THE SCIENTIFIC LITERATURE

Douglas Kondziolka, MD*, Kenneth Sochats, MS, MBA*
University of Pittsburgh, PA

INTRODUCTION: The existing format of the scientific literature – individual authoring and editing, parallel review, a user format that allows only reading – has not changed in over a century. The barriers to authorship and the creation of scientific works are significant, and the barriers to the access and use of peer-reviewed knowledge remain problematic. The current publishing industry has not addressed these issues. After an analysis of these barriers and the industry's response, we developed a new format for the literature based on an interactive network to address the needs of all parties, from author to user.

METHODOLOGY: Based on the concept that each scientific discipline is its own knowledge community, has its own terminology and demand for specific knowledge elements, we formatted the writing of text and data entry from the outset. Clinical reports, laboratory reports, clinical trials, reviews and case reports were created, along with menus for specific terms and data points to allow online, simultaneous, multi-author writing and editing. A new peer-review process was created where reports are reviewed within the article itself, and for the first time allows the peer-review process to be studied. If desired, users can ask questions of reports without reading through the report, and data from multiple reports on the same topic can be combined. "Help" was translated into ten languages. Resources for writing (guidelines, classifications) were embedded into the network and appeared automatically (i.e. the brain metastases guidelines when writing about brain metastases).

RESULTS: We first built a working prototype that was shown to authors and editors from different countries and disciplines, including the surgical editors group of the American College of Surgeons. They were surveyed on 24 specific questions related to the current and future state of writing, reviewing and use of information. 39/40 surveyed responded that a new method should be developed. Based on such feedback and after a four-year development process, the network, "World Science"(www.world-sci.com) was launched for global beta testing in April 2011. The disciplines of neurosurgery, radiation oncology, endovascular, and cardiology have been addressed to date and others are being built. The system was provided at no charge and copyright was maintained by the authors.

CONCLUSIONS: Using methods of metadata storage and analysis, we created a new format for the scientific literature from the "front end", modifying creation to use. The current method of writing and review is thought to be slow and not interactive. Current "back end" search of what is created does not allow users to efficiently find or know what they want to know. Development methods, key features, and initial use will be demonstrated. We believe that this format will radically alter the creation and use of credible science for all people.

SATURDAY, OCTOBER 22

8:40-8:48 CEREBRAL VEINS: "TO SACRIFICE OR NOT TO SACRIFICE, THAT IS THE QUESTION"

Mohamed Samy Elhammady, MD*, Roberto C. Heros, MD*
Department of Neurosurgery, University of Miami

INTRODUCTION/HYPOTHESIS:

Frequently, a neurosurgeon encounters a vein that limits exposure and he or she must make a decision as to whether the vein can be safely sacrificed. Unfortunately, there is insufficient literature to help guide us in this respect. The senior surgeon (RCH) has long held the opinion that there are important veins in specific locations that consistently can be sacrificed without consequent complications when necessary to obtain optimal exposure; in these cases, the consequences of limited or inadequate exposure of the pathology can be worse than the very small risk of a complication from venous occlusion**.**

METHODOLOGY

The pertinent literature on venous anatomy and on surgical results of venous occlusion in specific sites was reviewed. The experience of the senior author with elective occlusion of draining veins for specific surgical exposures was considered. Pertinent venous anatomy will be illustrated.

RESULTS

We found that the following specific veins can almost always be sacrificed, when necessary, without adverse neurologic consequences: I) Terminal branches of the Sylvian veins draining into the sphenoparietal and sphenobasal sinuses. The senior author has routinely sacrificed these veins to allow posterolateral retraction of the temporal tip during the combined frontotemporal "half and half' exposure for 104 cases of basilar top aneurysms and many other cases where the approach was used for tumors without a single serious complication that could be attributed to venous occlusion. 2) Pre-central cerebellar veins and bridging tentorial veins in the superior surface of the cerebellum. The senior author routinely sacrifices these veins when necessary for adequate exposure when using the supracerebellar infratentorial approach for pineal tumors and lesions of the superior cerebellum and anterior vermis such as arteriovenous malformations and tumors, again without any complications attributable to venous occlusion. The literature seems to confirm this practice. 3) Superior petrosal vein. The senior author has routinely sacrificed this vein for better exposure during microvascular decompressions of the trigeminal nerve in nearly 400 operations without adverse consequences. He did have a major complication from occlusion of this vein in a patient with a large acoustic neuroma and therefore with large tumors that may have occluded other important venous pathways, the situation may be different than with normal anatomy. The literature is less clear with respect to sacrifice of the petrosal vein. 4) Bridging veins to the occipital and marginal sinuses. The senior author's experience in approaches to the fourth ventricle and the literature agree on the fact that these veins can be sacrificed with impunity when necessary to obtain adequate exposure.

CONCLUSION

All important large veins should be preserved whenever possible. However, specific veins, as described above, can be sacrificed with minimal risk when necessary to obtain adequate surgical exposure.

SATURDAY, OCTOBER 22

9:00-9:08 INFLUENCE OF DURAL OPENING ON SYRINGOMYELIA AND SCOLIOSIS IN CHILDREN WITH CHIARI I MALFORMATION

Richard C.E. Anderson MD*, Todd C. Hankinson MD, and Neil A. Feldstein MD*

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INTRODUCTION: During the routine workup for children with early onset or atypical scoliosis, a small percent will be found to have a Chiari I Malformation (CM-I) and syringomyelia. While surgical treatment of the Chiari at an early stage has been shown to stabilize or reverse the scoliosis in many of these patients, the influence of dural opening as part of the surgical procedure is largely unknown. In this study, we compare the clinical and radiographic outcomes with regard to syringomyelia and scoliosis following posterior fossa decompression with or without duraplasty.

METHODS: The authors retrospectively reviewed the records of children with CM-I and syringomyelia who presented with scoliosis and underwent posterior fossa decompression with or without duraplasty. Clinical and radiographic outcomes were assessed between the two groups. Postoperative syrinx status on follow-up MRI at 6 months was described as resolved, improved, stable, or worsened. Scoliosis was evaluated through measurements of the Cobb angle of the largest scoliotic curve and was described as improved, stable, or progressed.

RESULTS: Suboccipital decompression with C1 laminectomy was performed in 22 patients. Non-dural opening procedures were performed in 8 patients (36%) while duraplasty was performed in 14 (64%). There were no significant differences in the rate of scoliosis progression (p=0.5) or other clinical outcomes between the two groups (p=1.0). Radiographic outcomes demonstrated a greater rate of syrinx resolution (31% versus 0%) and improvement (55% versus 44%) in the duraplasty group. Complication rates in the duraplasty group were similar to re-operation rates in the non-dural opening group (19% versus 13%).

CONCLUSIONS: In children with CM-I and syringomyelia with scoliosis, dural opening more reliably leads to radiographic syrinx improvement, but this does not translate into better clinical outcomes or reduce the need for future scoliosis surgery.

9:08-9:16 USING STATISTICAL PROCESS CONTROL METHODOLOGY TO DECREASE THE SHUNT INFECTION RATE AT A CHILDREN'S HOSPITAL

***Corey Raffel, MD**, PhD; Mike Fetzer, MS; Dennis Cunningham, MD*

INTRODUCTION: Statistical process control (SPC) methodology has been used by industry to decrease errors, decrease product defects, and improve efficiency. SPC has been applied to medical processes, resulting in improved outcomes and decreased costs. We have applied SPC to shunt procedures for hydrocephalus to decrease the incidence of shunt infections. We have achieved a statistically significant decrease in infections.

METHODS: A process control team identified the steps required from identifying a patient in need of a shunt procedure to getting them to the operating room. A checklist was made. Compliance with the checklist was monitored. Repeated meetings of the team examined compliance with the checklist. Leverage points were identified, and changes to the checklist were made based on these leverage points.

RESULTS: The initial checklist included specifications for pre-operative care of the patient, pre-operative antibiotic timing, hair clipping, and skin prep solution. Initially, the antibiotic used was cefazolin. However, we did not see a decrease in shunt infections by G chart, which monitors number of cases between infections. We changed to vancomycin and saw a decrease in shunt infections, but also a decrease in compliance with the timing of antibiotic delivery. The team agreed to change the specifications for vancomycin delivery, resulting in acceptable compliance. Since this change, we have done 146 consecutive shunt procedures without an infection, which far exceeds the p=.05 upper control limit of the G chart. Our 2009 shunt infection rate was 4.1% (12 infections in 294 cases). Having 0 infections in 146 cases is a significant decrease from the 2009 value, p=.011.

CONCLUSIONS: The use of SPC has resulted in a significant increase in the number of cases done without a shunt infection and a significant decrease in shunt infection rate. We have prevented approximately 6 shunt infections to date, with a cost savings of approximately $145,000.

9:20-9:28 DYE ENHANCED CONFOCAL ENDOMICROSCOPY IMPROVES VISUALIZATION OF HISTOPATHOLOGICAL FEATURES IN BRAIN TUMORS

Peter Nakaji, MD*, Nikolay Martisoyan, MD, Mark Preul, MD, PhD, Jennifer Eschbacher, MD, Robert F. Spetzler, MD. Barrow Neurological Institute, Phoenix, Arizona*

INTRODUCTION: A handheld confocal endomicroscope probe has been used experimentally by our group to identify infiltrative tumor margins and to make pathological diagnoses. At present most fluorescent agents used in humans are contrast agents. We sought to assess in animals the feasibility of enhancing the ability of this modality to provide rapid histological information during glioma surgery using fluorescent dyes that are not biocompatible in humans.

METHODS: Fifteen mice underwent craniectomy 14 days after implantation with GL261 cells. Acridine orange (0.01%), acriflavine (0.1%) and cresyl violet (0.1%) were each applied topically to the surface of the brain and tumor. Visible-wavelength fluorescent (VWF) images of normal brain, gross tumor, and peritumoral zones were collected using the handheld confocal endomicroscope probe. Histological samples were acquired from imaged areas. Histopathological features of corresponding confocal and H&E images were reviewed.
Results: Acridine orange, acriflavine and cresyl violet induced fluorescence of tumor cells detectable by VWF confocal endomicroscopy. Acridine orange and acriflavine provided nuclear detail, while cresyl violet showed cytoplasmic fluorescence. Fluorescent regional imaging correlated to tumor and peritumoral regions as confirmed by conventional histopathology. Confocal endomicroscopy revealed individual satellite tumor cells within peritumoral tissue, definitive tumor borders, and striking fluorescent cellular, and subcellular structures (e.g., mitoses, nuclei) in various tumor regions correlating with standard clinical histology and known tissue architecture. The total imaging time was about 3 minutes per biopsy specimen.

CONCLUSION: Confocal endomicroscopy provided rapid in vivo histological information in animals. These data suggest that confocal endomicroscopy in humans could be enhanced by applying these dyes in immediate ex vivo fashion to resected brain and tumor tissue. This mode of identification of cellular tumor and visualization of microscopic tumor cell invasion is substantially more rapid than frozen section diagnosis and may be able to improve intraoperative decision-making during resection of brain tumors.

9:28-9:36 CONTEMPORARY USES OF LASER INTERSTITIAL THERMAL THERAPY

Gene H. Barnett, MD, MBA, FACS
Brain Tumor Institute, Cleveland Clinic Foundation, Cleveland, OH

INTRODUCTION: Laser interstitial thermal therapy (LITT) is not new, but the concept preceded the development of technology to allow for it to be a useful neurosurgical tool. Recently, two LITT systems have received clearance by the United States Food and Drug Administration for intracranial use. Results of the First-in-Man (FIM) trial of the Monteris AutoLITT system were presented at a previous Academy meeting demonstrating safety and efficacy in terms of the ability of the system to accurately monitor and predict the extent of tissue ablation.

METHODOLOGY: Cases where the AutoLITT system were used to ablate intracranial lesions in an intraoperative MRI suite were reviewed. Unlike the FIM trial, indications were not restricted to recurrent glioblastoma and in some cases more than one trajectory of ablation were used.

RESULTS: To date, four patients have been treated – two with recurrent high-grade glioma, one with newly diagnosed glioblastoma, and one with medically refractory radiation necrosis. Complete radiographic ablation of enhancement was achieved in three of the patients. Two patients had temporary neurological deficits but none were sustained. The patient with steroid-dependent radiation necrosis had substantial improvement of his brain edema and discontinued steroids within six weeks of treatment. Time to perform each ablative trajectory was typically 2-3 hours. It is anticipated that additional cases will be presented at the meeting.

CONCLUSIONS: Laser interstitial thermal therapy appears to be an important emerging tool in the neurosurgical armamentarium and may provide a significant therapeutic option for radiosurgery- induced radiation necrosis.

9:36-9:44 SURGERY VS. RADIOSURGERY FOR THE TREATMENT OF MID-SIZED BRAIN METASTASES

***Raymond Sawaya, MD**, The University of Texas MD Anderson Cancer Center; Dima Suki, PhD, The University of Texas MD Anderson Cancer Center*

INTRODUCTION: Stereotactic Radiosurgery (SRS) is increasingly replacing surgical resections (SR) in the management of brain metastasis (BM). Tumor size generally favoring SR when tumor diameters exceed 3 em., and the converse is true for tumors of less than 1 em. diameter. The purpose of this study is to analyze the outcome of patients with tumor diameters between 1 and 3 em. that were treated with either modality.

MATERIAL: 1284 patients with 1 to 3 brain metastases were included. Of these, 638 underwent SR, and 616 SRS. The diameters of the tumors were further broken down. 695 had a diameter of 1 to 2 em., and 559 a diameter of 2 to 3 em. Clinical variables known to affect survival were analyzed and compared between the two treatments.

RESULTS: The median survival of the SR groups was 10.1 months and that of the SRS group was
7.27 months (HR 1.31, p=S:O.OOl). This survival advantage was even more evident when 2 to 3 em. diameter tumors were compared to 1 to 2 em. tumors (HR 1.48 vs HR 1.35). Other variables favoring SR included single metastasis, a lung or GI primary, RPA class I or II, and symptomatic patients. Further breakdown of the data will be presented at the meeting.

CONCLUSION: While SRS has shown effectiveness comparable to SR for small BM, the optimal cut- off size of treating BM with SRS has not been adequately determined in the literature. This study suggests that as metastatic tumors increase in diameters above 1 em. the effectiveness of SRS as compared to SR diminishes proportionately

9:50-9:58 EPIGENETIC PATHWAYS MODULATE REPAIR OF THE INJURED CENTRAL NERVOUS SYSTEM

***Bermans J. Iskandar, MD**, Department of Neurosurgery, University of Wisconsin*

INTRODUCTION: We have previously shown that the folate pathway plays a crucial role in repair of CNS neurons after injury, and that folic acid is an important mediator of such repair. We have further shown that this effect is directly related to DNA methylation, as the folate cycle has the unique function of being the sole methylation pathway in the body. We now show that these functions occur through a complex interaction of several interrelated epigenetic pathways, including DNA methylation, histone modifications, and microRNAs.

METHODS: Using anatomical, biochemical, and molecular techniques to study spinal axon regeneration after injury *in vivo* and *in vitro*, we have examined the relationship between spinal axon growth and epigenetic pathways that typically interact with DNA methylation.

RESULTS: 1. Folic acid treatment improves axon regeneration in mature rodent spinal neurons after injury, both *in vivo* and *in vitro*. The results show a biphasic dose response curve, with maximal spinal regeneration occurring at an optimal dose of folic acid (80µg/kg). **2.** The proregenerative effect of folate is mediated primarily by DNA methylation and the DNA methyltransferases (DNMTs). **3.** Global DNA methylation in the injured spinal cord with increasing doses of folic acid follows a biphasic dose response curve that corresponds to the biphasic curve seen with regeneration. **4.** The methylation of CpG sites on the promoters of genes involved in axon growth (*Gap-43, NaK-ATPase*, and *Gadd45a*) consistently follows biphasic curves corresponding to axon regeneration and global methylation. **5.** In our animal models, DNA methylation is dependent on the methylation of specific histones involved in transcriptional regulation, as well as microRNAs that regulate DNMT activity, relationships that are dose-dependent and reciprocal.

CONCLUSIONS: Our results reveal that regeneration of injured CNS axons is intimately related to a complex interplay of epigenetic mechanisms that work in concert to facilitate or hinder the methylation of DNA under injury conditions. These findings point to a mechanism in which environmental factors modulate the molecular machinery of healing CNS neurons.

9:58-10:06 DEVELOPMENT OF A NEUROMA-IN-CONTINUITY INJURY MODEL IN RODENTS

Jacob Alant, MBChB, MMed, FRCS(C) and ***Rajiv Midha, MD, MSc, FRCS(C)***
University of Calgary, CANADA

BACKGROUND: Management of traumatic neuroma-in-continuity (NIC) poses ongoing challenges for peripheral nerve surgeons. The absence of a clinically relevant experimental model continues to handicap our ability to investigate ways of better diagnosis and treatment for these disabling injuries.

OBJECTIVE AND METHODS: In search of a reproducible rodent NIC model, various injury techniques were tested and then refined on Lewis rat sciatic nerves. Optimal experimental injuries that consistently resulted in focal NIC histological features combined intense focal compression (with a malleus nipper) with mild (50g) traction forces. Nerves were harvested at various time points (0, 5, 13, 21 and 65 days) for histological examination. In separate experiments, skilled locomotion and kinetic ground reaction force (GRF) analysis were performed serially and up to 9 weeks on the experimental NIC (n=6) and crush-control (pure Sunderland grade 2) injuries (n=5).

RESULTS: Focal widening, disruption of endoneurium and perineurium with aberrant intra- and extrafascicular axonal regeneration and progressive fibrosis was consistently demonstrated in 14 of 14 nerves with refined experimental injuries. Moreover, we determined that the NIC range (when using intense compression combined with mild traction) falls within a narrow band, just below the nerve transection threshold, which is proportional to nerve size. This enabled us to extend the model to predictably inflict NIC injuries onto various nerves of different sizes, with disruption of fascicular content but preserved epineurial continuity, confirmed directly by *in vivo* imaging of nerve fibers immediately following the injuries using the “cellvizio” confocal fiber optic microscope system, and (at 4-7 days after the injuries) using conventional histology to study the three-dimensional axon and Schwann cell regeneration morphology in Sunderland grade 3-4 injuries. At 8 weeks, experimental animals displayed a significantly greater slip ratio in skilled locomotor assessments, compared to nerve crush animals ($p<.01$). GRF’s of the crush- injured animals showed earlier improvement compared to the experimental animals, whose overall GRF patterns in vertical and fore-aft force generation failed to recover as well as the crush-injury group. Ongoing experiments are correlating axonal misdirection and non-specific reinnervation as the anatomical substrate underlying poor behavioral performance in the experimental injury rats.

CONCLUSIONS: These histological features and poor functional recovery was consistent with NIC formation in a rat model, employing forces akin to those at play in clinical nerve injuries. This NIC model may serve as a tool to help us understand the pathology of these devastating injuries better in order to catalyze a breakthrough in early diagnostic and intervention strategies that would ultimately lead to improved patient outcomes.

10:30-10:38 TAMOXIFEN IS AN EFFECTIVE NEUROPROTECTANT IN AN ENDOVASCOUAR CANINE MODEL OF ISCHEMIC STROKE

***Alan S. Boulos, MD**, FACS; Farhad Bahrassa, MD; Ravi Gandhi, MD; Ahmed Galal, MD, all Albany Medical Center, Albany, NY; Doniel Drazin, MD, Cedars-Sinai Medical Center, Los Angeles, CA; John C. Dalfino, MD, Albany Medical Center, Albany, NY; A. John Popp, MD, FACS, Brigham and Woman's Hospital, Harvard Medical System, Boston, MA*

INTRODUCTION: Tamoxifen has been shown to be a potent neuroprotectant against stroke in rodents. Since other neuroprotectant medications have failed in human trials, a study of tamoxifen in a large animal model was necessary to further assess tamoxifen's effectiveness. For this study, the authors developed an endovascular model of anterior circulation infarction in canines to mimic the human clinical condition. We assessed the hypotheses that (1) we will be able to consistently produce an internal carotid artery (ICA) terminus infarction; and (2) tamoxifen is an effective neuroprotectant against stroke m carunes.

METHODS: On male beagles (N=48, weight 9-11 kg), bilateral femoral artery cutdowns were performed and the vertebral artery and left ICA were each selectively catheterized. Under fluoroscopic guidance, a microcatheter was introduced via the vertebral artery guiding the catheter into the basilar artery, posterior communicating artery and ICA terminus. A 1-ml clot was injected in the terminus occluding the middle cerebral artery (MCA) and anterior cerebral artery (ACA) origin. In the first 12 canines, the occlusions were confirmed by angiography. A Canine Stroke Score (CSS) was assigned (range 0-18, 0 is intact on exam, 18 is comatose). The animals were then euthanized and brains stained with 2,3,5- triphenyltetrazolium red dye (ITC). With these findings, a second study involving selective MCA catheterization and smaller infarcts were performed to improve survivability. The subsequent 36 canines underwent a blinded randomized study examining infusion of tamoxifen (either 5mg/kg or 10mg/kg) intravenously one hour after clot injection and either with or without recombinant TPA (0.5mg/kg intra-arterial) versus equal volume of vehicle (dimethyl sulfoxide, DMSO for tamoxifen, and saline for TPA). The animals were survived for three days then MRI was performed; TIC was performed to assess stroke size

RESULTS: Results show that in the first group, infarct volume and stroke scores were consistent with the extent of the occlusion of the angiographic vessels. An occlusion of the ACA, MCA and posterior cerebral artery (PCA) resulted in larger infarcts and higher stroke scores than those with an ACA and MCA occlusion. In the randomized blinded study, tamoxifen (both high and low doses) significantly reduced infarct size and improved clinical outcomes. Tamoxifen with TPA also was significantly smaller stroke size, however, the effects did not appear additive. The mean infarct volume reduction for tamoxifen treated animals was 40% ($p<0.05$). The mean tamoxifen treated Canine Stroke Score was significantly less than vehicle treated animals ($p<0.001$). There were significant correlations TIC determined volume, and neurological clinical outcome ($p<0.05$).

CONCLUSION: This endovascular model of stroke reliably reproduced infarctions similar in scope to a middle cerebral artery occlusion in humans. In addition, the angiographic findings could predict subsequent clinical course and infarction size. Tamoxifen was effective at significantly improving the canine neurological deficits and reducing the size of stroke. TPA did not adversely affect that improvement. In conclusion, this study took the first step in validating a reliable endovascular canine stroke model and also, demonstrated the effectiveness in canines of a potentially promising human neuroprotectant.

10:38-10:46 THE MYTH OF RESTENOSIS AFTER CAROTID ANGIOPLASTY AND STENTING

Felipe C. Albuquerque, MD; *Azam Ahmed, MD; Alim Mitha, MD; Cameron G. McDougall, MD*
Barrow Neurological Institute, Phoenix, AZ

INTRODUCTION: Based on CREST, carotid endarterectomy (CEA) and stenting have equivalent safety and efficacy. Endarterectomy is associated with a rate of restenosis as high as 18%. In this setting, we analyzed our experience with restenosis after carotid artery stenting (CAS).

METHODS: A retrospective chart review was conducted between 1995 and 2010. Symptomatic and asymptomatic patients were selected for stent placement based on NASCET and ACAS criteria. These patients underwent CAS with distal embolic protection. The indications, rates of technical success, intraoperative and perioperative complications, restenosis (>50%) rate, and clinical outcome were evaluated.

RESULTS: One-hundred seventy five patients were treated, but 24 were lost to follow-up. As a result, 151 patients with 165 lesions were evaluated. Seventy five percent of lesions were symptomatic. Indications for CAS included: poor surgical candidacy, prior endarterectomy, prior radiation, those randomized to stent placement as part of a study, acute occlusions, tandem stenosis, high bifurcation, and contralateral laryngeal nerve palsy. Procedures were technically successful in all but one case (0.6%). Intraoperative and perioperative stroke occurred in 4 patients (2.6%). Follow-up ranged from 6 months to 10 years (mean 1 year). Fourteen arteries (8.5%) developed a restenosis greater than 50%, but moderate to severe restenosis (>70%) occurred in only 3.6%. Only four patients developed symptomatic restenosis (2.6%). The highest risk factor for developing restenosis was a prior history of neck irradiation (33%) and prior CEA (20%). In fact, of the total 14 restenoses, 13 (93%) occurred in either the prior CEA or prior radiation treatment subgroups.

CONCLUSIONS: The rate of moderate to severe restenosis after carotid stent placement is quite low (3.6%) and is likely lower than that of CEA. In addition, restenosis after stenting occurs almost exclusively in patients with a prior history of CEA or neck irradiation.

10:46-10:54 MINIMALLLY-INVASIVE ENDOSCOPIC AND IMAGE-GUIDED EVACUATION OF INTRACEREBRAL HEMORRHAGE: TECHNIQUE AND RESULTS IN 38 CASES

Joshua Dusick, MD; Paul Vespa, MD; Daniel Hanley, MD; Justin Dye, MD; ***Neil Martin, MD*** *(Department of Neurosurgery, UCLA; Department of Neurology, Johns Hopkins)*

INTRODUCTION: Intracerebral Hemorrhage (ICH) is the only major stroke subtype without a clearly effective treatment. Investigations of the last decade have established that the extent of ICH-mediated brain injury relates directly to the volume of blood clot and duration of blood exposure to the brain tissue. We hypothesize that the optimal minimally invasive surgical technique would result in immediate evacuation of the hematoma without causing additional trauma thereby avoiding prolonged exposure of the perihematomal tissue to toxic blood breakdown products, and thus reducing subsequent edema, tissue injury, and disability. This report describes our experience with two minimally invasive burr hole techniques for evacuation of ICH.

METHODOLOGY: This report describes a prospective IRB-approved registry, focused on safety and efficacy of clot extraction, of spontaneous ICH cases treated within 48 hours of onset by minimally invasive (burr hole) endoscopic and image-guided surgery for supratentorial hematoma evacuation.

Over the course of our experience, the surgical technique evolved. In Group A, the hematoma was evacuated by insertion of the endoscope into the hematoma, and evacuating it by visually-guided suctioning and free-hand movement of the scope around the cavity. In Group B, using stereotactic image-guidance, the endoscope sheath (8 mm) was first inserted into a pre-planned location in the deep component of the hematoma, fixed in place using a hydraulic “arm”, and pressure-regulated suction was applied. After partial clot extraction, the sheath was withdrawn to a second location in the superficial component of the clot, and suction applied again. To reduce tissue disruption, there was no visually-guided maneuvering of the endoscope sheath or suction catheter around the cavity. After evacuating more than 70% of the hematoma volume, measured in a Luken trap, the hematoma cavity was inspected with the endoscope during irrigation to confirm adequate hemostasis. In rare cases monopolar or bipolar coagulation of bleeding vessels was performed, but in most cases irrigation alone resulted in hemostasis.

RESULTS: There were 23 patients in Group A (free hand endoscopic evacuation), and 15 patients in Group B (stereotactic image-guided evacuation). In Group A, the average hematoma reduction was 56%. In Group B clot volume reduction was 81%. There was no significant difference in the rate of re-hemorrhages (2 in Group A, 1 in Group B), or surgical complications (2 in Group A, 0 in Group B). The operative mortality within 1 month was 5 in Group A, and 1 in Group B. Average pre-op mRS was the same for the two Groups, but there was a trend toward a postoperative reduction in disability at the last followup **only** in Group B.

The variations in surgical technique will be presented in detail.

CONCUSION: Minimally invasive burr hole evacuation of ICH is effective for hematoma removal, and is best accomplished with an image-guided, minimal manipulation technique.

10:54-11:02 MOYAMOYA DISEASE: CURRENT CONCEPTS AND FUTURE PERSPECTIVES IN CLINICAL AND BASIC RESEARCH IN JAPAN

Kiyohiro Houkin, MD, *Department of Neurosurgery, Hokkaido University Graduate School of Medicine*

BACKGROUND: It is well known that surgical revascularization is effective for moyamoya disease. It is supposed to be safe surgery. However, the peri-operative complication and its morbidity has not well analyzed. The authors report complication and morbidity rate of surgical treatment for moyamoya disease. In addition, I will also refer to the recent concept of the pathogenesis of moyamoya disease and novel epidemiological facts.

PATIENTS AND METHOD: One hundred and thirty-two patients including 52 adults patients and 80 pediatric patients are included in this study. These are consecutive cases experienced in Hokkaido University and Sapporo Medical University from 1992 to 2004. For these 132 patients, 218 surgeries have been performed using combined surgical technique of direct bypass and indirect surgery of ecephalo-duro-arterio-myo-synangiosis (EDAMS).

RESULTS: Among these 218 surgeries, 8 cases of peri-operative complications including two cases of intracerebral hemorrhage, one case of serious seizure, two cases of cerebra infarction and two cases of infection are seen. Permanent neurological deficit has seen in two cases of intracerebral hemorrhage and one case of cerebral infarction. Therefore, the surgical morbidity was 2.3% for patients number and 1.4% for surgeries.

CONCLUSION: The complication and morbidity rate of combined surgery of direct and indirect bypass is supposed to be 1-4% for patients with moyamoya disease. The surgical treatment for moyamoya disease is quite safe option. However, this complication rate has to be considered in case of surgery in particular minimum symptomatic patients and adult hemorrhagic patients. In this talk, we refer to the current concepts and perspectives in basic and clinical research in Japan based on these clinical data.

11:10-11:18 DOES LOW DOSE RADIATION EXPOSURE LEAD TO THE DEVELOPMENT OF ACOUSTIC NEUROMAS?

*Oren Berkowitz, MS, PA(C), **L. Dade Lunsford, M.D., FACS**, Yueh-Ying, Han, Ph.D. and Evelyn Talbott, Ph.D. From the Department of Neurological Surgery, University of Pittsburgh School of Medicine and the Department of Epidemiology, Graduate School of Public Health, University of Pittsburgh*

INTRODUCTION: Controversy swirls about the potential role of low dose radiation exposure, including cell phone usage, to the development of acoustic neuroma. We performed a matched cohort trial of patients with acoustic neuroma to assess risk factors of exposure to commonly used diagnostic tools and phone technology that emit low dose ionizing and non-ionizing radiation.

METHODS AND MATERIALS: In the interval of 1997-2007, 822 patients underwent Gamma knife® radiosurgery for an acoustic neuroma. Fifty one percent (420 cases) participated in this retrospective study and 343 (42%) were age and gender matched to 343 controls (without a brain tumor) who were recruited from the neurosurgery spine disorders clinics at our institution. Using a self-administered questionnaire, information on exposure to medical radiation, use of cell phones, electrical appliances, and other potential risk factors were collected. Initial logistic regression was used to estimate an odds ratio (OR) and a 95% confidence interval (CI).

RESULTS: Adjusting for race, education, smoking, alcohol use, occupational exposure to noise, and a family history of cancer, an elevated OR was reported for individuals exposed to dental x-rays at least once every two to four years, compared to those x-rayed less than once every four years (OR=2.24, and 95% CI=1.14-4.39). A history of full mouth (Panorex) x-ray, computed tomography of the head and neck, other x-ray examinations, or radiation treatment of the head and neck region were not associated with an acoustic neuroma. Use of cell phones for more than ten years was not associated with the development of acoustic neuroma compared to non- users (odds ratio=1.36, 95% CI =0.71-2.62). Similarly, use of electrical appliances (hairdryers, electric shavers, electric blankets) was not associated with increased acoustic neuroma development.

DISCUSSION: In this matched cohort study, more frequent exposure to dental x-rays was the only ionizing or non-ionizing radiation exposure associated with a higher risk of the development of acoustic neuroma. Cell phone usage was not associated with the development of acoustic neuroma.

11:18-11:26 SHOULD ANYTHING BE DONE TO PRESERVE HEARING IN PATIENTS WITH INTRACANALICULAR VESTIBULAR SCHWANNOMAS?

Stephen J. Haines, MD*, Samuel C. Levine, MD, Christopher Hilton, MD, University of Minnesota School of Medicine*

OBJECTIVE: To compare long term hearing acuity and quality following microsurgical excision, radiosurgical control and watchful waiting of intracanalicular vestibular schwannoma

DESIGN: Systematic review of published literature and retrospective cohort analysis of the author's case series

MAIN OUTCOME MEASURES: hearing acuity measured by pure tone average or speech reception threshold, hearing quality measured by word recognition score, combined hearing function measured by AAO-HNS classification.

RESULTS: There are no randomized or matched-control comparisons of the long term quality of hearing preserved by the three methods of management studied. The author's series and large case series reported in the literature demonstrate similar rates of hearing preservation at three years following treatment or the initiation of watchful waiting. In watchful waiting patients approximately 45% of patients (Kaplan-Meier estimate) with AAOHS Class A or B hearing at diagnosis retain Class A or B hearing 5 years after diagnosis. In patients treated with radiosurgery the percentage is also approximately 45%. In the author’s surgical series of such patients operated upon by the middle fossa route, the estimate is 55% at 6 years. Insufficient data exists for any of the management options to make accurate estimates beyond 6 years after diagnosis or treatment.

CONCLUSIONS: Best available evidence does not clearly demonstrate a long term hearing preservation advantage for any available method of management. A clear demonstration of the superiority of one management method over another would require a substantial data collection effort from patients followed for more than 5 and probably 10 years after initiation of management and that data does not presently exist.

11:26-11:34 MICROSURGERY AND GAMMA KNIFE RADIOSURGERY FOR VESTIBULAR SCHWANNOMA: A BALANCED APPROACH

Basant Misra MBBS, MS, M Ch, Diplomate National Board, *Abhijit Warade MBBS, Harshad Purandare MBBS, MS, M Ch, Diplomate National Board, Rahul Ved MBBS, MS, Diplomate National Board.*
Department of Neurosurgery & Gamma Knife Radiosurgery,
P. D. Hinduja National Hospital & Medical Research Centre, Mumbai, India

AIM: An attempt is made to present our current management protocol in vestibular schwannoma (VS) patients where the same neurosurgeon advises and actually performs both microsurgery and Gamma Knife Radiosurgery (GKR).

MATERIAL AND METHODS: Background: Surgical experience of 627 cases of VS operated by the first author. Microsurgery was the first option in 486 and GKR was performed in 167 cases, 26 of the latter were previously operated by the author. An analysis of the 100 consecutive interventions in last 2 years was done to see the current practice and results.

RESULTS: Between June 16, 2009 and June 15, 2011, 65 patients of VS underwent microsurgery and 35 GKR were performed, 8 of the latter were previously operated by the author. Thus, 74% of the time microsurgery was the first option. There was no difference in the average age of patients treated by microsurgery (47.8 years) and GKR (47.0 years). All patients in GKR group and 35% of microsurgery group had tumor less than 3 cm in largest diameter. The indications of intervention in the GKR group were previous microsurgery (16), significant co-morbidities (5) and patient's choice (14). Microsurgery was performed in 62% of patients who were not previously operated and available for either treatment (<3cm tumor and medically fit). In the microsurgery group, the total excision rate was 83% and the facial function at discharge was Grade III or better in 90% of the patients. There was no operative mortality.

CONCLUSION: Microsurgery was the preferred treatment in the majority. GKR was preferred in patients with small tumor and significant co-morbidities or previous surgery. Less than 40% of otherwise healthy patients opted for GKR as the initial treatment. Performance of the modalities, microsurgery and GKR, by the same neurosurgeon reduces the bias and results in a more balanced approach.

11:34-11:42 "LIP SERVICE"

Michael B. Sisti, MD, *Neurological Institute of New York, New York Presbyterian Hospital Columbia University Medical Center*

The results of a ten year single neurosurgeon and single radiosurgeon at a single institution(Columbia University Medical Center, New York, NY) in the primary surgical or radiosurgical treatment of 383 acoustic neuromas is presented.

The focus of this hybrid treatment paradigm is to protect facial nerve function and minimize treatment morbidity. A total of 151 patients underwent total(55) or near total surgical(96) resection of tumors over 2.2 cm in size with an average tumor size of 3.3 cm with good facial nerve function(HB 1or 2)in 96% of patients. In the subtotally resected group 20 patients had tumor regrowth requiring radiosurgery with facial function the same or better post radiosurgery in 95% of patients. Patient age and tumor size was found to be significant in predicting total versus subtotal(> 90%) of tumor resection with respect to good facial nerve outcome. Patients with tumors less than 2. 2 cm in size(232) underwent Gamma Knife radiosurgery all with good facial nerve function and with 3 patients requiring follow up microsurgery due to progressive tumor growth after radiation. There were no patients deaths in the series and the 14 patients with post operative complications (CSF leak(11), hydrocephalus(2), and meningitis(1)) recovered. Four patients in the surgical group underwent gold weight tarsorraphies for facial weakness and no patients treated with Gamma Knife required this procedure.

The logic and technique of this hybrid method(surgery, radiosurgery, or both) of a single neurosurgeon treatment paradigm to maximize patient outcome with respect to facial preservation will be presented in detail.

11:42-11:50 BEVACIZUMAB TREATMENT FOR 31 PROGRESSIVE NF2-RELATED VESTIBULAR SCHWANNOMAS: HEARING AND VOLLUMETRIC RESPONSES AND DURATION OF RESPONSE

***Fred G. Barker II M.D.**, Vanessa Merker M.D., Scott R. Plotkin M.D. Ph.D.*

PURPOSE: Early studies suggest that bevacizumab treatment can result in hearing improvement in some neurofibromatosis 2 patients who have progressive vestibular schwannomas in their only hearing ear. We now report longer followup in a larger cohort of similarly treated NF2 patients.

PATIENTS AND METHODS: We studied 31 consecutive NF2 patients who received bevacizumab for progressive vestibular schwannomas at our center. Hearing was assessed using audiometry and tumor size was measured using volumetric MRI. A hearing response (loss) was defined as an improvement (decrease) in word recognition score above the 95th percentile confidence interval compared with baseline; a radiographic response (progression) was defined as a ≥ 20% decrease (increase) in tumor volume compared with baseline.

RESULTS: The median age was 26 years (range, 12 – 73 years) and 45% were male. The median volumetric tumor growth rate before starting treatment was 70% per year. At the time of analysis, the median duration of treatment was 14 months (range, 6 – 41 months). A hearing response (significant hearing improvement) occurred in 13/23 (57%) evaluable patients, and a volumetric radiographic response in 17/31 (55%) of evaluable patients. The median time to response was 3 months for both endpoints. 88% of patients had stable or decreased tumor size after 1 year of treatment, 67% at 2 years, and 54% at 3 years. 90% of patients had stable or improved hearing after 1 year of treatment, 81% at 2 years, and 61% at 3 years. Overall, treatment was well tolerated with only minor treatment toxicity.

CONCLUSION: Bevacizumab treatment was followed by hearing improvement and tumor shrinkage in over 50% of NF2 patients with progressive vestibular schwannomas, and stable or improved hearing was retained in the majority of patients after 3 years of treatment.

NOTES

SPECIAL GUESTS

Aviva Abosch Minneapolis, MN	Stephen Haines
Filipe Albuquerque Phoenix, AZ	Cameron McDougall
Richard C.E. Anderson New York, NY	Jeffrey Bruce
Nicholas Bambakidis Cleveland, OH	Warren Selman
Bernard Bendok Chicago, IL	Hunt Batjer
John Boockvar New York, NY	Howard Riina
Alan Boulos Albany, NY	A. John Popp
David Chalif New York, NY	Raj Narayan
H. Isaac Chen Philadelphia, PA	M. Sean Grady
Franco DeMonte Houston, TX	Raymond Sawaya
M. Samy Elhammady Miami, FL	Roberto Heros
Shogo Endo Hokkaido, JAPAN	Kiyohiro Houkin
Kelly Foote Gainesville, FL	William Friedman
Zoher Ghogawala Greenwich, CT	Fred Barker II
Grant, Gerald Durham, NC	Guy McKhann
Ricardo Hanel Jacksonville, FL	Robert Spetzler

Kimberly Harbaugh Hershey, PA	Robert Harbaugh
Tetsuyoshi Horiuchi Matsumoto, JAPAN	Kazuhiro Hongo
Dong Kim Houston, TX	Arthur Day
Shih-Shan Lang Philadelphia, PA	Eric Zager
Giuseppe Lanzino Rochester, MN	Bruce Pollock
Charles Liu Los Angeles, CA	Steven Giannotta,
Adel Malek Boston, MA	Carl Heilman
Michael Muhlbauer Memphis, TN	Jon Robertson
Peter Nakaji Phoenix, AZ	Volker Sonntag
Ian Pollack Pittsburgh, PA	Robert Friedlander
Michael Sisti New York, NY	Robert Solomon
Justin Smith Charlottesville, VA	Christopher Shaffrey
Viviane Tabar New York, NY	E. Sander Connolly
Phillip Tibbs Lexington, KY	Russell Travis
Chad Washington St. Louis, MO	Ralph Dacey
Jeffrey Wisoff New York, NY	Corey Raffel

ACADEMY AWARD WINNERS

Paul M. Lin	1955
Hubert L. Rosomoff	1956
Byron C. Pevehouse	1957
Norman Hill	1958
Jack Stern	1959
Robert Ojemann	1960
Lowell E. Ford	1962
Charles H. Tator	1963
Earle E. Crandall	1964
Stephen Mahaley, Jr.	1965
Chun Ching Kao	1966
John P. Kapp	1967
Yoshio Hosobuchi	1968
Gary G. Ferguson	1970
Richard L. Pressley	1971
David G. McLone	1972
Arden F. Reynolds, Jr.	1973
Richard L. Rapport	1974
Andrew G. Shetter	1975
John R. Howe	1976
Howard W. Blume	1977
Howard J. Senter	1978
Elisabeth M. Post	1979
David Dubuisson	1980
Dennis A. Turner	1981
Marc R. Mayberg	1982
David S. Baskin	1983
Kevin J. Kiwak	1984
Terry Lichtor	1985
Michael G. Nosko	1986
Joseph R. Madsen	1987
James T. Rutka	1988
Christopher D. Heffner	1989
Scott I. Gingold	1990
Mary Louise Hlavin	1991
Adam P. Brown	1992
Michael Tymianski	1993
David Garrett, Jr.	1994
L. Brannon Thomas	1995
John S. Yu	1996
Gregory Canute	1997
Nathan R. Selden	1998
Robert M. Friedlander	1999
Tien T. Nguyen	2000
Peng Chen	2001
Ganesh Rao	2002
Gelarch Zadeh	2003

MEETINGS OF THE ACADEMY

Hotel Netherland Plaza, Cincinnati, Ohio …….	October 28-29, 1938
Roosevelt Hotel, New Orleans, Louisiana ……	October 27-29, 1939
Tudor Arms Hotel, Cleveland, Ohio ……..	October 21-22, 1940
Mark Hopkins Hotel, San Francisco, California ……	November 11-15, 1941
Ambassador Hotel, Los Angeles, California ……	November 11-15, 1941
The Palmer House, Chicago, Illinois ……..	October 16-17, 1942
Hart Hotel, Battle Creek, Michigan..……	September 17-18, 1943
Ashford General Hospital, White Sulphur Springs, West Virginia ……..	September 7-9, 1944
The Homestead, Hot Springs, Virginia ……	September 9-11, 1946
Broadmoor Hotel, Colorado Springs, Colorado ……	October 9-11, 1947
Windsor Hotel, Montreal, Canada ……..	September 20-22, 1948
Benson Hotel, Portland, Oregon …….	October 25-27, 1949
Mayo Clinic, Rochester, Minnesota ……	September 28-30, 1950
Shamrock Hotel, Houston, Texas ……	October 4-6, 1951
Waldorf-Astoria Hotel, New York City, New York .....……..	September 29-October 1, 1952
Biltmore Hotel, Santa Barbara, California ……	October 12-14, 1953
Broadmoor Hotel, Colorado Springs, Colorado ……	October 21-23, 1954
The Homestead, Hot Springs, Virginia …….	October 27-29, 1955
Camelback Inn, Phoenix, Arizona ……..	November 8-10, 1956
The Cloister, Sea Island, Georgia …….	November 11-13, 1957
The Royal York Hotel, Toronto, Canada …….	November 6-8, 1958
Del Monte Lodge, Pebble Beach, California ……	October 18-21, 1959
Copley Sheraton Plaza, Boston, Massachusetts ……	October 5-8, 1960
Royal Orleans, New Orleans, Louisiana ……..	November 7-10, 1962
El Mirador, Palm Springs, California ……	October 23-26, 1963
The Key Biscayne, Miami, Florida…….	November 11-14, 1964
Terrace Hilton Hotel, Cincinnati, Ohio …….	October 14-16, 1965
Fairmont Hotel & Towers, San Francisco, California ……	October 17-19, 1966
The Key Biscayne, Miami, Florida ……..	November 8-11, 1967
Broadmoor Hotel, Colorado Springs, Colorado ……	October 6-8, 1968
St. Regis Hotel, New York City ……..	September 21, 1969
Camino Real, Mexico City, Mexico……	November 18-21, 1970
Sahara-Tahoe Hotel, Stateline, Nevada ……	September 26-30, 1971
New College, Oxford, England ……	September 4-7, 1972
Huntington-Sheraton Hotel, Pasadena, California ……	November 14-17, 1973
Southampton Princess Hotel, Bermuda……	November 6-9, 1974
The Wigwam (Litchfield Park), Phoenix, Arizona ……...	November 5-8, 1975
Mills Hyatt House, Charleston, South Carolina …….	November 10-13, 1976
Mauna Kea Beach Hotel, Kamuela, Hawaii …….	November 2-5, 1977
Hotel Bayerischer Hof, Munich, Germany ……	October 22-25, 1978
Hyatt Regency, Memphis, Tennessee …….	November 7-10, 1979
Waldorf-Astoria Hotel, New York City, New York ……	October 1-4, 1980
Sheraton Plaza, Palm Springs, California …….	November 1-4, 1981

Ritz-Carlton Hotel, Boston, Massachusetts ……. October 10-13, 1982
The Lodge at Pebble Beach, California …… October 23-26, 1983
The Homestead, Hot Springs, Virginia ……October 17-20, 1984
The Lincoln Hotel Post Oak, Houston, Texas …… October 27-30, 1985
The Cloister, Sea Island, Georgia ……. November 5-8, 1986
Hyatt Regency, San Antonio, Texas…… October 7-10, 1987
Omni Netherland Plaza, Cincinnati, Ohio ……. September 13-17, 1988
Loews Ventana Canyon, Tucson,
Arizona ....……. September 27-October 1, 1989
Amelia Island Plantation, Amelia Island, Florida …… October 2-7, 1990
Salishan Lodge, Gleneden Beach, Oregon ……. September 22-26, 1991
Ritz-Carlton Hotel, Naples, Florida …… October 21-25, 1992
The Wigwam, Phoenix, Arizona …… October 27-30, 1993
The Cloister, Sea Island, Georgia …… November 3-6, 1994
Loews Ventana Canyon Resort, Tucson, Arizona …… November 1-5, 1995
The Greenbrier, White Sulphur Springs,
West Virginia …… September 18-22, 1996
Rimrock Resort, Banff, Alberta, Canada ……. September 10-14, 1997
Four Seasons Biltmore, Santa Barbara, California …… November 4-7, 1998
Ritz-Carlton, Amelia Island, Florida ……... November 10-13, 1999
The Broadmoor, Colorado Springs, Colorado …… October 11-14, 2000
The Breakers, Palm Beach, Florida…….. November 14-17, 2001
The Phoenician, Scottsdale, Arizona . . . . . …… October 16-19, 2002
Colonial Williamsburg, Williamsburg, VA ……... October 29-November 1, 2003
Four Seasons Berlin and
Taschenbergpalais Dresden Germany . . . . . …… October 3-8, 2004
Ritz-Carlton, Half Moon Bay, California . . . . . …… September 21-24, 2005
Ritz-Carlton, Reynolds Plantation, Greensboro, GA …..…… October 18-21, 2006
Ritz-Carlton, Lake Las Vegas, Nevada ……..... October 31-November 3, 2007
Barrow Neurological Institute Phoenix and
Enchantment Resort, Sedona Arizona …… September 10-13, 2008
The Breakers, Palm Beach, Florida …… November 4-7, 2009
The Inn at Spanish Bay, Pebble Beach, California…….. November 3-6, 2010
The Fairmont Scottsdale Princess, Scottsdale, Arizona……... October 19-22, 2011

PAST PRESIDENTS

Dean H. Echols..... 1938-39
Spence Braden..... 1940
Joseph P. Evans..... 1941
Francis Murphey 1942
Frank H. Mayfield..... 1943
A. Earl Walker 1944
Barnes Woodhall..... 1946
William S. Keith 1947
Howard A. Brown 1948
John Raaf..... 1949
E. Harry Botterell..... 1950
Wallace B. Hamby 1951
Henry G. Schwartz..... 1952
J. Lawrence Pool 1953
Rupert B. Raney..... 1954
David L. Reeves..... 1955
Stuart N. Rowe..... 1956
Arthur R. Elvidge..... 1957
Jess D. Herrmann 1958
Edwin B. Boldrey..... 1959
George S. Baker 1960
C. Hunter Shelden 1961-62
Samuel R. Snodgrass . 1963
Theodore B. Rasmussen1964
Edmund J. Morrissey 1965
George Maltby 1966
Guy L. Odom 1967
James G. Galbraith 1968
Robert H. Pudenz . 1969-70
William B. Scoville ... 1971
Robert L. McLaurin ... 1972
Lyle A. French 1973
Benjamin B. Whitcomb1974
John R. Green..... 1975
William H. Feindel 1976
William H. Sweet..... 1977
Arthur A. Ward 1978
Robert B. King 1979
Eben Alexander, Jr. ... 1980
Joseph Ransohoff II ... 1981
Byron C. Pevehouse .. 1982
Sidney Goldring 1983
Russel H. Patterson, Jr.1984
Thomas Langfitt..... 1985
Phanor L. Perot, Jr..... 1986
Shelley N. Chou 1987
James T. Robertson ... 1988
Thoralf M. Sundt, Jr. . 1989
Robert Ojemann 1990
Nicholas Zervas..... ….1991
Henry Garretson 1992
George Tindall..... 1993
William A. Buchheit .. 1994
David L. Kelly, Jr. 1995
John M. Tew, Jr. 1996
Julian T. Hoff 1997
Edward Connolly..... 1998
J. Charles Rich..... 1999
George A. Ojemann.... 2000
Roberto C. Heros...…2001
Donald O. Quest….....2002
David G. Piepgras.….2003
Volker K.H. Sonntag.2004
Martin B. Camins…...2005
L. Nelson Hopkins….2006
Richard Morawetz….2007
Robert F. Spetzler…..2008
Ralph G. Dacey, Jr….2009
Steven Giannotta …...2010
Robert A. Solomon…2011

PAST VICE-PRESIDENTS

Francis Murphey 1941
William S Keith 1942
John Raaf 1943
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J Lawrence Pool..... 1952
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Martin B. Camins……...2002
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Theodore B. Rasmussen.	1951-53
Eben Alexander.....	1954-57
Robert L. McLaurin.....	1958-62
Edward W. Davis	1963-65
Robert G. Fisher.....	1966-68
Byron C. Pevehouse.....	1969-72

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Nicholas T. Zervas.....	1987-89
William A. Buchheit.....	1990-92
Julian T. Hoff.....	1992-95
Roberto C. Heros	1995-98
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THEODORE ROBERTS……1976…… **.....**……2007
Seattle, Washington
(Senior)

R. C. L. ROBERTSON.....1946.....1985
Houston, Texas
(Senior)

STEWART ROWE.....1938.....1984
Pittsburgh, Pennsylvania
(Senior)

KEIJI SANO .....1975.....2011
Minato-ku, Tokyo JAPAN
(Honorary)

RICHARD SCHNEIDER.....1970.....1986
Ann Arbor, Michigan
(Senior)

KURT-FRIEDRICH SCHURMANN1978…… .....…2005
Mainz, GERMANY
(Senior Corresponding)

HENRY SCHWARTZ.....1942.....1998
St. Louis, Missouri
(Senior)

WILLIAM SCOVILLE.....1944.....1984
Hartford, Connecticut
(Senior)

R. EUSTACE SEMMES .....1955.....1982
Memphis, Tennessee
(Honorary)

C. HUNTER SHELDEN .....1941.....2003
Pasadena, California
(Senior)

ROBERT SMITH .....1989.....2003
Jackson, Mississippi
(Senior)

SAMUEL SNODGRASS.....1939.....1975
Galveston, Texas
(Senior)

GLEN SPURLING.....1942.....1968
La Jolla, California
(Honorary)

C. WILLIAM STEWART..... 1948 1948
Montreal, Quebec, CANADA
(Corresponding)

KENICHIRO SUGITA 1988 1994
Nagoya, Japan
(Senior Corresponding)

THORALF SUNDT, JR. 1971 1992
Rochester, Minnesota
(Active)

ANTHONY SUSEN……1965…… .....…….2008
Burgess, Virginia
(Senior)

HENDRIK SVIEN 1957 1972
Rochester, Minnesota
(Active)

HOMER SWANSON..... 1949 1987
Atlanta, Georgia
(Senior)

WILLIAM SWEET 1950 2001
Brookline, Massachusetts
(Senior)

ALFRED UIHLEIN..... 1950 1990
Rochester, Minnesota
(Senior)

JOHN VAN GILDER (Kerstin)1980…… 2007
Iowa City, IA
(Senior)

A. EARL WALKER 1938 1995
Albuquerque, New Mexico
(Senior)

EXUM WALKER (Nellie)… .1938……2001
Atlanta, GA
(Senior)

ARTHUR WARD, JR...... 1953 1997
Seattle, Washington
(Senior)

THOMAS WEAVER, JR. 1943 1985
Dayton, Ohio
(Senior)

W. KEASLEY WELCH 1957 1996
Waban, Massachusetts
(Senior)

BENJAMIN WHITCOMB ... 1947 1998
Surrey, Maine
(Senior)

BARNES WOODHALL 1941 1985
Durham, North Carolina
(Senior)

FRANK WRENN 1973 1990
Greenville, South Carolina
(Senior)