



THE SOCIETY OF UNIVERSITY NEUROSURGEONS

Houston, Texas

2018
ANNUAL MEETING
March 22-25, 2018



Houston, Texas 2018

MD Anderson Cancer Center

As lead organizer of SUN 2018, which will be held in Houston on March 22-25, I invite you to join us for what promises to be an outstanding meeting in the Bayou City. The weather in March is the best of the year, avoiding the chills of winter and the humid heat of summer, and we have planned a comfortable and elegant venue, an introduction to the host program (M D Anderson) assisted by our partners at Baylor, and interesting speakers and cultural and social activities. Houston is America's fourth largest city, and contains a population that is as diverse as it is welcoming. The meeting is tentatively scheduled to be held at the Hotel Zaza in the Museum District, adjacent to Rice University, Hermann Park with its outstanding zoo and golf course, multiple museums, and of course, the Texas Medical Center where both M D Anderson and Baylor proudly reside. The variety and richness of Houston is vast: it is the home of Beyonce, petrochemical plants, 26 Fortune 500 companies, America's astronaut corps, fine neighborhoods, major league sports teams, the biggest concentration of medical expertise on the planet, the world's first domed stadium (the Astrodome, still standing), theater and music of every genre, shopping that yields objects of desire at every level, and thousands of restaurants to suit all gastronomic tastes. As the town that was named after Sam Houston, that sent Neil Armstrong to the moon (where "Houston" was the word first spoken from the lunar surface), where air conditioning was invented, it has a colorful history that peeps out at you in unexpected places. This mix of economic power, intellectual heft, and cultural diversity is the only major city in the US without zoning, and it has the busiest port in the nation for foreign tonnage despite not being technically on the ocean. It is the most ethnically diverse major city in America, and it contains some of the nicest, most welcoming people you will meet anywhere. Please come take part in a SUN meeting where old friends will come together, new friends will be made, and where we will learn from each other while enjoying the quirkiness, elegance, and unexpected beauty you will find in Houston, a city like no other.



Ian McCutcheon, MD

Local Host, SUN 2018

Professor, Department of Neurosurgery

Division of Surgery, UT MD Anderson Cancer Center, Houston, TX

Present Officers

President

Michael Wang

President-Elect

Richard Ellenbogen

Vice President

Erol Veznedaroglu

Secretary/Treasurer

Felipe Albuquerque

Member-at-large

Daniel Yoshor

Historian

Ken Smith

Membership Committee

Kadir Erkmen

Ian McCutcheon

Christina Notarianni

Rich Anderson

Future Site Committee

Ruth Bristol

Michael Kaiser

Anthony Sin

Jeff Sorenson

CME Committee

Daniel Hoh

Previous Meetings

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

~~~~~1988~~~~~  
University of Tübingen  
Tübingen, FRG

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

~~~~~2014~~~~~  
University of Washington  
Seattle, WA

~~~~~2015~~~~~  
Huashan Hospital Fudan University
Shanghai, China

~~~~~2016~~~~~  
Barrow Neurological Institute  
Phoenix, AZ

~~~~~2017~~~~~  
University of Cape Town
Cape Town, South Africa

Past Presidents

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

~~~~~2014~~~~~  
Sander Connolly, MD

~~~~~2015~~~~~  
Jacques Morcos, MD

~~~~~2016~~~~~  
Michael Levy, MD

~~~~~2017~~~~~  
Nelson Oyesiku, MD

# 2018 Meeting Attendees

## SUN Members

Albuquerque, Felipe, MD  
Amin-Hanjani, Sepideh, MD  
Anderson, Richard, MD  
Binning, Mandy, MD  
Bristol, Ruth, MD  
Bruce, Jeffrey, MD  
Boulis, Nicholas, MD  
Camarata, Paul, MD  
Charbel, Fady, MD  
Chin, Lawrence, MD  
Choi, David, MD  
Connolly, E Sander, MD  
DeMonte, Franco, MD  
Ecklund, James, MD  
Ellenbogen, Richard, MD

Erkmen, Kadir, MD  
Heilman, Carl, MD  
Hoh, Daniel, MD  
Kaiser, Michael, MD  
Krieger, Mark, MD  
Krishnamurthy, Satish, MD  
Kurpad, Shekar, MD  
Lavine, Sean, MD  
Levy, Michael, MD  
Liebman, Kenneth, MD  
Liu, Charles, MD  
Markert, James, MD  
McCutcheon, Ian, MD  
Morcos, Jacques, MD  
Ogilvy, Christopher, MD  
Origitano, Thomas, MD

Oyesiku, Nelson, MD  
Prabhu, Sujit, MD  
Preul, Mark, MD  
Rabb, Craig, MD  
Rosen, Charles, MD  
Rosenwasser, Robert, MD  
Sisti, Michael, MD  
Smith, Kenneth, MD  
Solomon, Robert, MD  
Sorenson, Jeffrey, MD  
Tibbs, Philip, MD  
Tronnier, Volker, MD  
Veznedaroglu, Erol, MD  
Wang, Michael, MD  
Yoshor, Daniel, MD  
Zedah, Gelareh, MD

## Members' Guests

**Britz, Gavin, MD**  
(Lavine, Sean, MD)

**Chen, P. Roc, MD**  
(Erkmen, Kadir, MD)

**Huang, Jason, MD**  
(Chin, Lawrence, MD)

**Kan, Peter, MD**  
**Ropper, Alexander, MD**  
**Sheth, Sameer, MD**  
**Weiner, Howard, MD**  
(Yoshor, Daniel, MD)

**Lang, Frederick, MD**  
**Tatsui, Claudio, MD**  
**Raza, Shaan, MD**  
(McCutcheon, Ian, MD)

**Martin, Michael, MD**  
**Park, Paul, MD**  
**West, G. Alexander, MD**  
(Wang, Michael, MD)

**Mrak, Goran, MD**  
(Kaiser, Michael, MD)

**Riesenburger, Ron, MD**  
(Heilman, Carl, MD)

**Sekhar, Laligam, MD**  
(Ellenbogen, Richard, MD)

**Sughrue, Mike, MD**  
(Rabb, Craig, MD)

**Vyas, Nilesh, MD**  
(Ecklund, James, MD)

# Distinguished Service Award



**Jacques J. Morcos, M.D.,  
F.R.C.S. (Eng), F.R.C.S. (Ed),  
FAANS**

**D**r. Jacques Morcos is a Professor and Co-Chairman in the Department of Neurosurgery at the University of Miami, with a joint appointment in the Department of Otolaryngology. He is Director of Cerebrovascular and Skull Base Surgery at Jackson Memorial Hospital/University of Miami. He is Division Chief of Cranial Neurosurgery at Jackson Memorial Hospital and Director of the Skull Base and Cerebrovascular Fellowship Program. He obtained his Medical Degree from the American University in Beirut, Lebanon in 1985, and then spent four years in England, including spending time as Registrar at the National Hospital for Neurological Diseases at Queen Square and Maida Vale in London. During his time in the UK, he won the Henry Arthur Dalziel Ferns Prize from the Royal College of Surgeons of Edinburgh, Scotland, "for the most outstanding

candidate in the worldwide Primary FRCS examinations for the year 1987/1988 among more than 1,400 candidates". He then moved to the USA and completed neurosurgical residency at the University of Minnesota from 1990 to 1994, where he won the Peyton Society Award, "for ranking 1st in the USA on the American Board of Neurological Surgery (ABNS) written exam of 1993". He then completed a six month Fellowship at the University of Florida under Dr Arthur Day in Cerebrovascular Surgery, and then a one year Fellowship at the Barrow Neurological Institute 1994/1995 in Cerebrovascular and Skull Base Surgery under Dr Robert Spetzler. He joined the Department of Neurosurgery at the University of Miami in 1995 where he has been ever since.

His range of clinical expertise includes all skull base and complex brain tumors, endoscopic skull base surgery, and all aspects of cerebrovascular surgery including bypass surgery for complex aneurysms, Moyamoya and ischemic disease. Dr. Morcos is very active in organized and academic neurosurgery, nationally and internationally. He is Past Chair or Past President of: the Joint AANS/CNS Section on Cerebrovascular Surgery, the North American Skull Base Society (NASBS), the Society of University Neurosurgeons (SUN) and the World Association of Lebanese Neurosurgeons (WALN). He is Chair of the Annual meeting of the AANS for 2018 and was voted into the AANS Board of Directors for 2018-2021. He is very involved in the WFNS (World Federation of Neurosurgical Societies) where he is past Chair of the Cerebrovascular Committee and Continental Second Vice President representing North America, and currently Chair of the Constitution & Bylaws Committee. He was Scientific Chairman of the WFNS 14th World Congress of Neurological Surgery which was held in Boston in 2009. He is past Chair of the International Outreach Committee of the AANS and past member of the AANS Nominating Committee. Among his other commitments, he is member of the Congress of Neurological Surgeons, WFNS delegate of the American Academy of Neurological Surgery, member of the Senior Society, and several other societies. He is a reviewer on several Editorial Boards, including "Journal of Neurosurgery", "Neurosurgery", "World Neurosurgery", "Journal of Neurological Surgery Part B: Skull Base" and others. His most recent awards include being inducted into the Alpha Omega Alpha Honor Medical Society (2018), selected by US World and News Report (top 1% of US physicians, 2017), Patients' Choice Award (top 5% of US physicians, 2017) and International Who's Who of Professionals (2015).

Dr. Morcos is passionate about education, nationally and globally. He is dedicated to teaching, and has led and participated in numerous courses and symposia over the years. He has been invited to give more than 550 national and international presentations and 75 Visiting Professorships/Guest Lectureships. He greatly enjoys trips with his family, his wife Fiona and their three children Isabella, John and Christina. His hobbies include alpine skiing, cycling, swimming, traveling and math/physics.

# Special Speaker



## Dr. Michael Barratt

**D**r. Michael Barratt is a NASA astronaut and physician with a particular interest in adaptive physiology and human performance associated with weightlessness and fractional gravity, along with intersections with other extreme environments.

He completed residency training in internal medicine at Northwestern University and aerospace medicine at Wright State University, and has worked at the NASA Johnson Space Center since 1991. He has worked extensively with Russian space medical counterparts at the Institute of Biomedical Problems in Moscow and the Gagarin Cosmonaut Training Center in Star City during the course of the US/Russian Shuttle Mir and developing International Space Station (ISS) programs. He served as lead crew surgeon for the first NASA / Mir flight and for several Space Shuttle flights and contributed heavily to the development of the onboard medical system for ISS.

Dr. Barratt was selected into the NASA astronaut class of 2000 and has continued to train, work medical and life sciences issues for the crew office, and occasionally fly in space since then. He served as ISS flight engineer on Expeditions 19 and 20 commuting to the station on the Soyuz TMA-14 vehicle and spending 199 days in orbit. Barratt performed two spacewalks in the Russian Orlan suit and participated in a vigorous onboard science and construction program. He also flew as a crewmember of the STS-133 mission in 2011, the final flight of the Space Shuttle Discovery, serving as lead robotics and rendezvous officer.

Except for pauses as deputy chief of the astronaut office and program manager of NASA's Human Research Program, Dr. Barratt continues to train as an active member of the astronaut corps and works heavily with the Commercial Crew and Orion Programs in applying medical standards to new vehicle design and operations. Mike has served for years as the associate editor for space medicine for the journal *Aerospace Medicine and Human Performance* and is lead editor for the text book 'Principles of Clinical Medicine for Space Flight'. He is a fellow of the Aerospace Medical Association and lectures frequently in space medicine for introductory and formal training programs in the US and elsewhere, shamelessly hoping to focus new enthusiasm and talent toward the fledgling prince of medical specialties.

# Welcome to Dubrovnik SUN 2019

Dear Colleagues, dear Friends,

The Department of neurosurgery, University Clinical Centre Zagreb, is honored and delighted to host the 2019 SUN meeting in the Dubrovnik Palace Hotel, Dubrovnik, Croatia, from 26<sup>th</sup> to 30<sup>th</sup> June 2019.

The Department of neurosurgery, University Clinical Centre Zagreb is the oldest neurosurgical department, connected with the undergraduate and postgraduate neurosurgical programs in University of Zagreb School of Medicine which celebrates 100 years of existence.

The Neurosurgery Department was established after the second World War, and was organized like most of European neurosurgery departments, with first stereotactic procedure taking place in 1965 and first microsurgical procedure performed in 1970, only a few years after Yasargil and Donaghy.

The City of Dubrovnik, declared a World Heritage Site by UNESCO in 1979, is the jewel of Croatian tourism, sitting in the southernmost part of Croatia. It harbors centuries of heritage created by the noble skills and finest builders and artists, and became most prominent touristic destination in the Mediterranean Sea. The prosperity of the city was historically based on maritime trade, as the capital of the maritime Republic of Ragusa. During the 15<sup>th</sup> and 16<sup>th</sup> Century it became notable for its wealth and skilled diplomacy, and used to be an independent merchant republic for 700 years until Napoleon conquer the region. Dubrovnik has high education tradition which dates back to the 17<sup>th</sup> Century when Collegium Ragusinum, as a first public institution of higher education, was established.

The City itself is completed in the 13<sup>th</sup> Century and its walls remained virtually unchanged to the present days. Apart from some earthquakes that demolished its beauty, the last attacks to its Beauty were held in 1990 during the armed conflict.

The City is surrounded by the 1940m long defensive walls with only two main entrances to the old town. The most famous promenade which is called "Stradun" is surrounded with fountains, Gothic and Renaissance facades of the Sponza palace and Ducal palace, and Baroque church of St. Blasius, Jesuit College and lot of different other buildings. To enjoy in its beauty, the Croatian Neurosurgical Society has organized the joint meeting with the AANS in 2008 with great impact on the professional development and strengthening ties in neurosurgical community.

The Department of neurosurgery University Clinical Centre Zagreb would like to invite colleagues whose life is dedicated to neurosurgery to share the ideas, experiences and knowledge, and enjoy the remarkable City of Dubrovnik and its surroundings, and taste the local food with astonishing view of the Adriatic sea, to enjoy music in lovely Palaces and streets, and to feel tranquility of this divine place.

We hope that Dubrovnik, with its remarkable history and astonishing beauty, will leave everybody moved and delighted, in words of Bernard Shaw: "Those who seek paradise on Earth, should come to Dubrovnik".

Warm regards!



Goran Mrak MD, PhD, Local Host, SUN 2019

Department of neurosurgery,

University Clinical Centre Zagreb, EU





# Meeting Schedule

Thursday, March 22, 2018

|               |                   |                                                                                                 |
|---------------|-------------------|-------------------------------------------------------------------------------------------------|
| 6:00-8:30 pm: | Welcome Reception | Poolside - Hotel ZaZa<br>Ultimate Ransom<br>(weather backup)<br>Music by The Will Van Horn Trio |
|---------------|-------------------|-------------------------------------------------------------------------------------------------|

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Friday, March 23, 2018

|                |                                                                                     |                                                |
|----------------|-------------------------------------------------------------------------------------|------------------------------------------------|
| 6:30-8:30 am:  | Breakfast Buffet                                                                    | Phantom Ballroom<br>Hotel ZaZa                 |
| 7:00-8:00 am:  | Executive Committee Meeting (Executive only)                                        | Napoleon<br>Hotel ZaZa                         |
| 8:00 am:       | Buses to MD Anderson                                                                |                                                |
| 8:15-11:55 am: | Scientific Session                                                                  | Hickey Auditorium<br>MD Anderson Cancer Center |
|                | Moderator:                                                                          | McCutcheon, Ian, MD<br>Yoshor, Daniel, MD      |
| 8:15-8:24 am:  | History of neurosurgery at MDACC /<br>Advances in the treatment of brain metastasis | Sawaya, Raymond, MD                            |
| 8:24-8:33 am:  | Pituitary tumors and neurofibromatosis:<br>an unlikely pairing                      | McCutcheon, Ian, MD                            |
| 8:33-8:42 am:  | Malignant tumors of the skull base                                                  | DeMonte, Franco, MD                            |
| 8:42-8:51 am:  | Innovative therapies for glioma:<br>The Delta-24-RGD oncolytic adenovirus           | Lang, Frederick, MD                            |
| 8:51-9:00 am:  | En bloc resection for primary spinal neoplasms                                      | Rhines, Laurence, MD                           |
| 9:00-9:09 am:  | The MDACC fellowship in neurosurgical oncology                                      | Weinberg, Jeffrey, MD                          |
| 9:09-9:18 am:  | Brain mapping at MDACC                                                              | Prabhu, Sujit, MD                              |
| 9:18-9:27 am:  | Novel immunotherapy strategies for gliomas                                          | Heimberger, Amy, MD                            |
| 9:27-9:36 am:  | Laser interstitial therapy for spinal tumors                                        | Tatsui, Claudio, MD                            |
| 9:36-9:51 am:  | Break                                                                               |                                                |
| 9:51-10:00 am: | History of neurosurgery at Baylor<br>College of Medicine                            | Yoshor, Daniel, MD                             |

|                        |                                                                                                                                                                                                                                                                                                                                                     |                                                           |
|------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------|
| 10:00-10:09 am:        | The Baylor/MDACC residency program                                                                                                                                                                                                                                                                                                                  | Ganesh, Rao, MD                                           |
| 10:09-10:18 am:        | Pediatric neurosurgery and epilepsy surgery                                                                                                                                                                                                                                                                                                         | Weiner, Howard, MD                                        |
| 10:18-10:27 am:        | The TCH/Baylor fetal neurosurgery program                                                                                                                                                                                                                                                                                                           | Whitehead, William, MD                                    |
| 10:27-10:36 am:        | Meeting the challenge of meningioma:<br>from bench to bedside                                                                                                                                                                                                                                                                                       | Patel, Akash, MD                                          |
| 10:36-10:45 am:        | Psychiatric neurosurgery: a window to the future                                                                                                                                                                                                                                                                                                    | Sheth, Sameer, MD                                         |
| 10:45-10:54 am:        | Advances in endovascular neurosurgery                                                                                                                                                                                                                                                                                                               | Kan, Peter, MD                                            |
| 10:54-11:03 am:        | The Baylor spine surgery program                                                                                                                                                                                                                                                                                                                    | Ropper, Alexander, MD                                     |
| 11:03-11:12 am:        | The legacy of Ben Taub Hospital in neurosurgical<br>critical Care                                                                                                                                                                                                                                                                                   | Robertson, Claudia, MD                                    |
| <b>11:15-11:20 am:</b> | <b>Walk from MD Anderson to Baylor</b>                                                                                                                                                                                                                                                                                                              |                                                           |
| <b>11:25-11:55 am:</b> | <b>Talk by Guest Speaker</b><br>O. Howard “Bud” Frazier MD<br>Professor of Surgery<br>Baylor College of Medicine<br>Chief, Cardiopulmonary Transplantation<br>Texas Heart Institute                                                                                                                                                                 | One Baylor Plaza<br>(walk from MDACC to<br>Baylor, 5 min) |
| 11:55 – 12:15 pm:      | Visit to DeBakey Library/ Museum                                                                                                                                                                                                                                                                                                                    | One Baylor Plaza (adja<br>cent to talk)                   |
| <b>12:20 pm:</b>       | <b>Buses to Hotel ZaZa</b>                                                                                                                                                                                                                                                                                                                          |                                                           |
| 12:30-1:15 pm:         | Lunch                                                                                                                                                                                                                                                                                                                                               | Phantom Ballroom<br>Hotel ZaZa                            |
| <b>1:00-4:00 pm:</b>   | <b>Tour at your leisure / Free time to explore:</b><br><br>NASA Johnson Space Center Bus provided, leaving from Hotel ZaZa<br><br>Alternately: Visits to Museums (MFAH, Children’s Museum, Holocaust Museum,<br>Menil Collection, Contemporary Arts Museum, The Health Museum, McGovern<br>Centennial Gardens) or to Houston Zoo or Japanese Garden |                                                           |
| <b>5:30pm:</b>         | <b>Buses to Cocktails &amp; Dinner</b><br>Easily walkable from hotel (5 min)– bus is an option for guests who do not want<br>to walk, and for weather backup                                                                                                                                                                                        |                                                           |
| 6:00-7:00 pm:          | Cocktails                                                                                                                                                                                                                                                                                                                                           | Cullen Hall of Gems<br>& Minerals                         |
| 7:00-10:00 pm:         | Dinner                                                                                                                                                                                                                                                                                                                                              | Cockrell Butterfly<br>Center Lobby                        |

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## Saturday, March 24, 2018

|                 |                                                                                                                                                                                               |                                               |
|-----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------|
| 6:30-8:30 am:   | Breakfast Buffet                                                                                                                                                                              | Phantom Ballroom<br>Hotel ZaZa                |
| 7:00-8:00 am:   | <b>SUN Business Meeting<br/>(members only)</b>                                                                                                                                                | <b>Phantom Ballroom<br/>Hotel ZaZa</b>        |
| 7:00am-12:00pm: | Exhibits                                                                                                                                                                                      | Déjà Vu & Hemingway<br>Hotel ZaZa             |
| 8:00-9:20 am:   | Scientific Session 1                                                                                                                                                                          | Phantom Ballroom<br>Hotel ZaZa                |
| 8:00-9:20 am:   | Moderator:                                                                                                                                                                                    | Bristol, Ruth, MD<br>Krieger, Mark, MD        |
| 8:00-8:10 am:   | Does Tethered Cord Release in Adults Improve Symptomatology?                                                                                                                                  | Martin, Michael, MD                           |
| 8:10-8:20 am:   | Angioplasty for Intracranial Vertebrobasilar Stenosis: a Meta-Analysis of Procedural Risks                                                                                                    | Amin-Hanjani, Sepideh, MD                     |
| 8:20-8:30 am:   | MSC-Derived Exosomes Carrying microRNAs in the Treatment of Human Gliomas                                                                                                                     | Lang, Frederick, MD                           |
| 8:30-8:40 am:   | Is Prophylactic Untethering Necessary in Myelomeningocele Patients Undergoing Scoliosis Corrective Surgery?                                                                                   | Anderson, Richard, MD                         |
| 8:40-8:50 am:   | Safety of Ketamine as a Sedative in High Grade Aneurysmal Subarachnoid Hemorrhage                                                                                                             | Vyas, Nilesh, MD                              |
| 8:50-9:00 am:   | Trevo Real World Registry Results: Lessons Learned in Stroke Intervention                                                                                                                     | Veznedaroglu, Erol, MD                        |
| 9:00-9:10 am:   | An Argument for Neurogenic-Induced Severe Apnea as the Potential Initiating Event in Sudden Death or Cardiopulmonary Arrest Following SAH: An Experimental Study and Review of the Literature | Britz, Gavin, MD                              |
| 9:10-9:20 am:   | Deep Brain Stimulation for the Treatment of Refractory Obesity                                                                                                                                | Tronnier, Volker, MD                          |
| 9:20-9:50 am:   | <b>BREAK/VISIT EXHIBITORS</b>                                                                                                                                                                 | <b>Déjà vu &amp; Hemingway<br/>Hotel ZaZa</b> |

|                 |                                                                                                                                                                                 |                                          |
|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------|
| 9:50-10:50 am:  | <b>Scientific Session 2</b>                                                                                                                                                     | Phantom Ballroom<br>Hotel ZaZa           |
| 9:50-10:50 am:  | <b>Moderator:</b>                                                                                                                                                               | Kaiser, Michael, MD<br>Erkman, Kadir, MD |
| 9:50-10:00 am:  | The Development of a Precision Medicine Approach to ALS                                                                                                                         | Boulis, Nicholas, MD                     |
| 10:00-10:10 am: | USC Epilepsy Consortium: Creation of a Patient-Centered Ecosystem for Epilepsy Care                                                                                             | Liu, Charles, MD                         |
| 10:10-10:20 am: | Epidemiological and Environmental Factors Affecting the Incidence and Outcomes of Neurosurgical Procedures in a Semi-rural Montana: Observations Leading to Changes in Practice | Origitano, Thomas, MD                    |
| 10:20-10:30 am: | ChRO-Seq: A New Tool to Identify RNA Sequences Associated with Glioblastoma Cells                                                                                               | Chin, Lawrence, MD                       |
| 10:30-10:40 am: | Connectomic Maps of Large Scale Human Brain Networks and Their Application to Brain Surgery                                                                                     | Sughrue, Michael, MD                     |
| 10:40-10:50 am: | Natural History and Endovascular Management of Dural Arteriovenous Fistulas                                                                                                     | Albuquerque, Felipe, MD                  |

## SPECIAL GUEST LECTURE

|                       |                                     |                                                                      |
|-----------------------|-------------------------------------|----------------------------------------------------------------------|
| 10:50-11:20 am:       | The Body in Space: A New Physiology | Barratt, Michael, MD                                                 |
| 11:20-11:30 am:       | Introduction of the President       | Lavine, Sean, MD                                                     |
| 11:30-Noon:           | Presidential Address                | Wang, Michael, MD                                                    |
| <b>12:15-1:00 pm:</b> | <b>Buses to Ranch Bar-B-Q</b>       |                                                                      |
| 1:00-3:00 pm:         | Lunch & Fun                         | George Ranch Historical Park, Richmond, Texas<br>30 miles from hotel |

|                |                     |                                                                                                |
|----------------|---------------------|------------------------------------------------------------------------------------------------|
| 3:15-4:15 pm:  | Buses to Hotel ZaZa |                                                                                                |
| 6:30-7:15 pm:  | Reception           | Fountain Room Hotel ZaZa<br>music is by The Galindo De Monte Porat Trio                        |
| 7:30-9:00 pm:  | Gala Dinner         | Fountain & Ultimate Ransom<br>Hotel ZaZa                                                       |
| 9:00-11:00 pm: | Music/dancing       | Fountain & Ultimate Ransom<br>Hotel ZaZa Music by Ricky Davis and the Ricky Davis Classic Band |

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## Sunday, March 25, 2018

|                  |                                                                                                                                                                                               |                                          |
|------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------|
| 7:00-9:00 am:    | Breakfast                                                                                                                                                                                     |                                          |
| 8:00am-11:20 am: | Exhibits                                                                                                                                                                                      | Déjà Vu & Hemingway<br>Hotel ZaZa        |
| 8:00-9:10 am:    | Scientific Session 3                                                                                                                                                                          | Phantom Ballroom<br>Hotel ZaZa           |
| 8:00-9:10 am:    | Moderator:                                                                                                                                                                                    | DeMonte, Franco, MD<br>Charbel, Fady, MD |
| 8:00-8:10 am:    | Carbon Fiber Components for Reconstruction after Resection of Spine Tumors                                                                                                                    | Choi, David, MD                          |
| 8:10-8:20 am:    | The Icon and the Iconoclasts                                                                                                                                                                  | Sisti, Michael, MD                       |
| 8:20-8:30 am:    | The Development of an Endovascular CSF Shunt                                                                                                                                                  | Heilman, Carl, MD                        |
| 8:30-8:40 am:    | The Relationship between Surgical Site Drains and Reoperation for Wound-Related Complications Following Posterior Cervical Spine Surgery: a Multicenter Retrospective Study of 1,799 Patients | Riesenburger, Ron, MD                    |
| 8:40-8:50 am:    | ACS NSQIP Surgical Risk Calculator Accurately Predicts Risk for Increased Hospital Cost in Neurosurgical Patients                                                                             | Hoh, Daniel, MD                          |

|                      |                                                                                                                                                             |                                                                     |
|----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------|
| 8:50-9:00 am:        | Salvage Treatment for Locally and Systemically Recurrent Skull Base Chordomas                                                                               | Raza, Shaan, MD                                                     |
| 9:00-9:10 am:        | Cervical Traction for the Treatment of Unstable Subaxial Injuries                                                                                           | Huang, Jason, MD                                                    |
| <b>9:10-9:40 am:</b> | <b>BREAK/VISIT EXHIBITORS</b>                                                                                                                               |                                                                     |
| 9:40-11:10 am:       | Scientific Session 4                                                                                                                                        | Phantom Ballroom<br>Hotel ZaZa                                      |
| 9:40-11:00 am:       | Moderator:                                                                                                                                                  | Morcos, Jacques, MD<br>Hoh, Daniel, MD                              |
| 9:40-9:50 am:        | Outcome of Combined Endovascular and Surgical Treatment of Unruptured Anterior Communicating Artery Aneurysms: Should More Aggressive Treatment Be Offered? | Ogilvy, Christopher, MD                                             |
| 9:50-10:00 am:       | Vein of Galen Malformations: The Texas Children's Hospital Experience in the Modern Endovascular Era                                                        | Kan, Peter, MD                                                      |
| 10:00-10:10 am:      | Current MCA Aneurysm Treatment: a Single-Institution Experience                                                                                             | Mrak, Goran, MD                                                     |
| 10:10-10:20 am:      | Delayed Clearance and Perivascular Stasis of Macromolecules as a Pathognomionic Feature of Hydrocephalus: an Experimental Study                             | Krishnamurthy, Satish, MD                                           |
| 10:20-10:30 am:      | Laser Interstitial Thermotherapy for Spinal Metastatic Disease Provides Reduced Morbidity and Less Delay to Systemic Therapy Compared to Open Surgery       | Tatsui, Claudio, MD                                                 |
| 10:30-10:40 am:      | Transnasal Endoscopic Skull Base Approaches in Children: a Single-Institution Experience                                                                    | Levy, Michael, MD                                                   |
| 10:40-10:50 am:      | The Evolving Neurosurgical Paradigm for Tuberous Sclerosis Complex                                                                                          | Weiner, Howard, MD                                                  |
| 10:50-11:00 am:      | Risk Factors Associated with 90-day Readmissions after Degenerative Lumbar Fusion                                                                           | Park, Paul, MD                                                      |
| 11:00-11:10 am:      | Quantitative MRA Screening and Submaximal Angioplasty is Cost-Effective for Symptomatic Vertebrobasilar Occlusive Disease                                   | Charbel, Fady, MD                                                   |
| 11:10-11:20 am:      | Final Announcements and Adjournment                                                                                                                         | Wang, Michael, MD<br>McCutcheon, Ian, MD<br>Albuquerque, Felipe, MD |

## Learning Objectives

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

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

## Accreditation/ Continuing Medical Education (CME)

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

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

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## Educational Format

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

# Disclosure Information

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| Name                      | Disclosure                                                                                                                 | Type of Relationship*                                                                                   |
|---------------------------|----------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------|
| Britz, Gavin, MD          | TRRI Research grant                                                                                                        | University Grants/Research Support                                                                      |
| Charbel, Fady, MD         | President, Founder, VasSol Inc                                                                                             | Stocks or Shareholder                                                                                   |
| Chin, Lawrence, MD        | Walbridge Fund                                                                                                             | University Grants/Research Support                                                                      |
| Choi, David, MD           | National Institute for Health Research (UK)<br>Wellcome Trust<br>European Research Council                                 | University Grants/Research Support                                                                      |
|                           | Stryker<br>DePuy Synthes                                                                                                   | Consultant Fee                                                                                          |
| Heilman, Carl, MD         | Cerevasc LLC<br>Cerevasc LLC                                                                                               | Consultant Fee<br>Consultant Fee                                                                        |
| Heiberger, Amy, MD        | Merck, Moleculin<br>Caris Life Science<br>Caris Life Science<br>Celldex Therapeutics                                       | Industry Grant Support<br>Consultant Fee<br>Stocks or Shareholder (Royalties)                           |
| Hoh, Daniel, MD**         | The Spine Journal<br>Editorial Board Member                                                                                | Stipend                                                                                                 |
| Huang, Jason, MD          | NIH NINDS                                                                                                                  | University Grants/Research Support                                                                      |
| Kan, Peter, MD            | NCI/Brain Cancer SPORE:<br>2P50CA127001<br>Stryker, Medtronic,<br>Microvention, Siemens<br>Stryker, Medtronic<br>Inneuroco | University Grants/Research Support<br>Industry Grant Support<br>Consultant Fee<br>Stocks or Shareholder |
| Krishnamurthy, Satish, MD | REaCH foundation grant                                                                                                     | University Grants/Research Support                                                                      |
| Lang, Frederick, MD       | DNAtrix, Inc.                                                                                                              | Patent Holder                                                                                           |
| Levy, Michael, MD         | Sony Olympus Corporation                                                                                                   | Industry Grant Support                                                                                  |



|                       |                                                                                                                                                                                                                    |                                                           |
|-----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------|
| Liu, Charles, MD      | BRAIN Initiative, NIH, NSF, DARPA, DOD, USC Office of the Provost, USC Office of the Dean, PAC 12 Conference, Society of Urodynamic, Female Pelvic Medicine, and Urogenital Reconstruction, LK Whittier Foundation | University Grants/Research Support                        |
|                       | Integra, KLS-Martin, Nexstim, Phagenesis, Microtransponder, Asterias Biotherapeutics, NeuroPace                                                                                                                    | Industry Grant Support                                    |
| McCutcheon, Ian, MD** | The University of Texas MD Anderson Cancer Center                                                                                                                                                                  | Employee                                                  |
| Morcos Jacques, MD    | Kogent                                                                                                                                                                                                             | Stocks or Shareholde                                      |
| Park, Paul, MD        | Pfizer, Vertex<br>Globus, Medtronic, NuVasive, Allosource                                                                                                                                                          | Industry Grant Support<br>Consultant Fee                  |
| Patel, Akash, MD      | "Establishing the Genomic Landscape of Human Atypical Meningiomas" National Institute of Neurological Disorders and Stroke (NINDS), Grant Number: K08NS102474                                                      | University Grants/Research Support                        |
| Rao, Ganesh, MD       | Congress of Neurological Surgeons                                                                                                                                                                                  | Fiduciary Position [of any organization outside the AANS] |
| Rhines, Laurence, MD  | Stryker, Medtronic                                                                                                                                                                                                 | Consultant Fee                                            |
| Riesenburger, Ron, MD | HD Life Sciences physician advisory board                                                                                                                                                                          | Consultant Fee                                            |
| Sheth, Sameer, MD     | UH3 NS103549, NINDS R01 MH106700, NIMH Dana Foundation grant<br>McNair Foundation Scholarship<br>Caroline Wiess Law Scholarship<br>Medtronic, Boston Scientific                                                    | University Grants/Research Support<br>Consultant Fee      |
| Sughrue, Michael, MD  | Medtronic, Synaptiv-consulting fees for teaching courses                                                                                                                                                           | Consultant Fee                                            |
| Tatsui, Claudio, MD   | Medtronic inc.                                                                                                                                                                                                     | Consultant Fee                                            |

|                         |                                                                                                                                                                                                                                                     |                                                                                                                                    |
|-------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------|
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| Vyas, Nilesh, MD        | Inova Health Systems                                                                                                                                                                                                                                | Employee                                                                                                                           |
| Vezenadaroglu, Erol, MD | Penumbra, Stryker<br>Penumbra, Stryker<br>NextGen Biologics,<br>Penumbra, VICIS<br>Stryker<br>Stryker                                                                                                                                               | Industry Grant Support<br>Consultant Fee<br>Stocks or Shareholder<br>Honorarium<br>Speakers Bureau                                 |
| Wang, Michael, MD       | Dept. of Defense<br>Depuy-Synthes Spine<br>K2M, Stryker<br>ISD<br>Globus<br>Depuy-Synthes Spine                                                                                                                                                     | University Grants/Research Support<br>Consultant Fee<br>Stocks or Shareholder<br>Honorarium<br>Other Financial or Material Support |
| Yoshor, Daniel, MD      | NINDS<br>NEI<br>DARPA<br>VA Merit Award<br>Second Sight                                                                                                                                                                                             | University Grants/Research Support<br>Industry Grant Support                                                                       |

**Those who have reported they do not have any relationships with commercial interests:**

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Weinberg, Jeffrey, MD  
Weiner, Howard, MD  
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\*\*These persons planned or contributed to the planning of this CME activity.

# Abstracts

## **Does Tethered Cord Release in Adults Improve Symptomatology?**

*Martin, Michael, MD*

### Introduction:

Tethered cord release is classically associated with myelomeningocele in pediatric neurosurgery patients. However, surgical management in adults diagnosed with tethered cord syndrome remains controversial. In this study, we describe our clinical outcomes related to tethered cord release in adult patients treated at the University of Oklahoma Health Sciences Center.

### Methods:

We performed a retrospective review on all adult patients, 18 years or older, undergoing tethered cord release performed at our home institution between 2005 and 2016. Clinical records, hospital charts, and imaging studies were reviewed through the last available follow-up.

### Results:

Thirty-two patients underwent tethered cord release between 2005 and 2016, of which 18 (56%) were female and 14 (44%) were male. Eleven patients (34%) were diagnosed with a fatty filum terminale, 5 (16%) with myelomeningocele, 4 (12%) with lipomyelomeningocele, 2 (6%) with a low-lying conus, 1 (3%) due to trauma, and 9 (28%) due to other congenital causes. The most common presenting symptoms were pain in 17 patients (53%), urinary incontinence in 15 (47%), and lower extremity weakness in 9 (28%). Complicating factors in pre-operative assessment included scoliosis in 5 patients (16%) and syringomyelia in 5 patients (16%). Initial medical management was attempted in 26 patients (81%). The most common post-operative complication was urinary retention in 7 patients (22%) of which 2 cases (28%) were permanent. Seven patients (22%) reported improvement in symptomatology following surgery, while 23 (72%) reported no change in symptoms. Average follow-up was 6.2 months.

### Discussion:

Our patient cohort highlights the complexity of treating tethered cord syndrome in adults. The underlying pathology and presenting complaints can be quite variable. Medical management when attempted may delay surgery, but all 26 patients attempting medical intervention eventually required surgery for worsening symptoms. In the post-operative period, patients most commonly reported

improvement in their pain or urinary incontinence. Most patients saw no change in their symptoms following surgery, but two patients developed urinary retention.

### Conclusion:

The role of tethered cord release in adults remains controversial. High-quality, randomized controlled studies could shed light on this problem and offer better practical guidelines regarding treatment of tethered cord syndrome in adults.

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## **Angioplasty for intracranial vertebrobasilar stenosis: a meta-analysis of procedural risks**

*Amin-Hanjani, Sepideh MD*

### Background:

Symptomatic flow-compromised intracranial vertebrobasilar (VB) stenosis carries a significant risk of stroke. Although flow restoration through endovascular interventions represents the most plausible treatment strategy, the high periprocedural risk of stenting, especially for the basilar artery, has proven prohibitive. Submaximal angioplasty alone may represent a safer strategy. We examined the peri-procedural risks associated with VB submaximal angioplasty.

### Methods:

All English language studies of intracranial angioplasty for atherosclerotic disease were screened. Studies were included in the meta-analysis based on the following criteria: submaximal angioplasty alone, identifiable peri-procedural outcomes for VB angioplasty,  $\geq 5$  patients. Our primary outcome was the 30 day stroke/ death event rate. We used Q statistics to test heterogeneity, and random-effect models using DerSimonian-Laird estimator to summarize effect sizes. Funnel plots and regression tests were performed to detect publication bias.

### Results:

Six studies, comprising 127 patients, met inclusion criteria. The Q test ( $p=0.90$ ) indicated homogeneity across studies. The pooled event rate was 5.9% (95% CI, 2.9%- 8.9%). The funnel plot and a non-significant regression test ( $p=0.30$ ) indicated no publication bias. Examination for event rate of vertebral vs basilar angioplasty showed no statistically significant risk difference.

## Conclusions:

Submaximal angioplasty represents a potentially promising intervention for symptomatic intracranial VB stenosis. These results support the need to prospectively examine the safety and feasibility of the intervention in high-risk flow compromised VB patients.

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## **MSC-derived Exosomes Carrying microRNAs in the Treatment of Human Gliomas**

*Lang, Frederik, MD*

A promising new paradigm in GBM therapy is treatment with microRNAs (miRs), which are small, noncoding RNAs that are powerful regulators of gene expression. We and others have shown that certain miRs (e.g., miR-124 and miR-128) are capable of inhibiting the growth of gliomas in vitro. However, because miRs are unstable in blood, it is currently unknown how these miRs will be delivered to patients. To address this problem, we exploited the observation that bone marrow mesenchymal stem cells (MSCs) secrete exosomes, which are nanoscale (50-100nm) vesicles that function as intercellular transport vehicles. We hypothesize that exosomes from cultured MSCs (called Exos) can be used to systemically deliver anti-glioma miRs to GBMs. To test this hypothesis, we first showed that MSCs could package miRs-of choice into exosomes. Specifically, MSCs were transduced with lentiviruses containing miR-124 or miR-128, and after 48hrs exosomes (Exos-miR-124 or Exos-miR-128) were isolated from the supernatant, lysed, and RNA was analyzed by qRT-PCR using primers for miR-124 and miR128. The level of miR-124 or miR-128 in the collected exosomes was significantly greater than controls ( $P < 0.0001$ ). To show that the isolated Exos are capable of homing to human gliomas in vivo, we labeled Exos with an infrared dye (DiR-Exos) and injected them intraperitoneally (IP), intravenously (IV), or intra-arterially (IA) into mice harboring intracranial gliomas (U87, GSC267 or GSC17). Bioluminescence imaging identified DiR-Exos exclusively within the tumors, with IA resulting in the highest signal, but IP and IV also being effective. To demonstrate that Exo-miRs are able to inhibit the growth of GSCs and down regulate target genes, we treated a panel of 5 GSCs with Exo-miR-124 and showed a significant reduction in viability of all GSCs compared with controls. Analyses of post-treatment protein lysates by immunoblot using an antibody to the known miR-124 target gene, FoxA2, showed treatment with Exo-miR-124 was capable of down regulating FoxA2. In similarly designed experiments, treatment of GSC17

or U87 with Exo-miR-128 also resulted in significant reduction in cell viability, and inhibition of miR-128 target genes, BMI-1 and SUZ. In order to assess efficacy of Exos in in vivo, GSC267 was implanted into the frontal lobe of nude mice (N=8/group) and after 7 days animals were treated with Exo-miR-124, Exo-miR-Ctrl, or PBS by IP injection (1010 Exos/100 l) every other day until the animals became moribund. Whereas all controls were dead by 60 days after tumor implantation (median survival Exos miR-Ctrl = 54 days; PBS = 55 days), 50% of the animals treated with Exos-miR-124 were alive at 90 days (median survival: 79 days,  $P < 0.0001$ ). Taken together, these data support the concept that systemically delivered exosomes carrying an anti-glioma miR can home to brain tumors, inhibit target genes and kill GSCs in vivo. These data provide the first proof that Exos can be used as vehicles for intravascular delivery of anti-glioma miRs.

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## **Is Prophylactic Untethering Necessary in Myelomeningocele Patients Undergoing Scoliosis Corrective Surgery?**

*Anderson, Richard, MD*

Hannah E. Goldstein, Thejas Hiremath, Christopher DeAllie, Megan Campbell, Peter J. Madsen, Benjamin C. Kennedy, Robert M. Campbell, Gregory G. Heuer, Todd C. Hankinson, Michael G. Vitale, Neil Feldstein, and Richard C. E. Anderson

### Introduction:

Many patients with myelomeningocele go on to develop scoliosis. They are also at increased risk of spinal cord re-tethering throughout their life. Some centers perform prophylactic untethering on myelomeningocele patients even in asymptomatic patients prior to scoliosis corrective surgery, as a tethered spinal cord can result in worsening neurologic function post-operatively. Other centers argue that untethering is not without inherent risks, and a prophylactic surgery is unnecessary. To date, little data exists on the relative risks or merits of either approach, and current practice is largely based on single center experience.

### Methods:

This is a multicenter retrospective cohort study of patients with myelomeningocele who were managed with or without prophylactic untethering prior to scoliosis corrective surgery. Data are being collected from eight centers that routinely perform scoliosis surgery, with various practices for prophylactic untethering. Baseline data, intra-operative reports,

and 90-day post-operative outcomes were analyzed to assess for differences in neurologic outcomes, scoliosis correction, surgical site infections (SSIs), and overall length of stay.

#### Results:

Preliminary results are based on 149 scoliosis surgeries in myelomeningocele patients, across three institutions. Mean age at surgery was 9.5 years old, with 54% males and 46% females. Changes in neuromonitoring were found in less than 3% of cases, with only 1 patient exhibiting worsened neurologic function post-operatively. Overall SSI rate was 16%; however, 50% of the surgeries following prophylactic untethering were complicated by infection, compared to only 13% of the surgeries without untethering. Patients who underwent prophylactic untethering prior to scoliosis surgery stayed in the hospital, on average, 2 days longer than those who did not.

#### Discussion:

The vast majority of myelomeningocele patients undergoing scoliosis corrective surgery have good neurologic outcomes regardless of prophylactic untethering. However, those who undergo an elective dural opening procedure for prophylactic untethering prior to scoliosis correction are more likely to experience SSIs and longer hospital stays.

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### **Safety of Ketamine as a Sedative in High Grade Aneurysmal Subarachnoid Hemorrhage**

*Vyas, Nilesh, MD*

#### Introduction:

Delayed cerebral ischemia (DCI) is commonly associated with high-grade aneurysmal subarachnoid hemorrhage (aSAH). Optimal management of DCI includes maintaining permissive or induced hypertension which can be challenging in heavily sedated patients. Ketamine is a hemodynamically stable analgesic sedative that has not been studied in this population. We hypothesize that Ketamine infusion (K), as compared to traditional sedatives (C), can be safely used in aSAH patients.

#### Methods:

We retrospectively reviewed aSAH patients admitted (1/2015-2/2017) less than 48 hours after aneurysm rupture and who required mechanical ventilation for greater than 72 hours. We excluded patients who presented with cardiac arrest or were made DNR within 48 hours of admission. We identified two cohorts: those sedated with ketamine infusion for at least 48 hours (K= 16), and those sedated with traditional sedatives—

propofol, fentanyl or midazolam (C= 29). Demographic, disease severity, clinical outcome measures, dose and timing of ketamine infusion, and hemodynamics were assessed before and after initiation of ketamine. DCI was defined as a new infarction after post-bleed day (PBD) 14 on a non-contrast head CT (NCCT) as compared to NCCT obtained 24-48 hours after aneurysm treatment (clipping or coiling).

#### Results:

Both groups had similar baseline characteristics and disease severity. Ketamine infusion had no significant effect on hemodynamics, pressor requirements or DCI rates. Tracheostomy rates and hospital length of stay (LOS) favored group K. Group K had a statistically insignificant higher VLOS (ventilator length of stay) and intensive care unit (ICU) LOS.

#### Conclusions:

Our data and analysis suggest that ketamine is a safe alternative sedative in aSAH patients. Future studies can identify potential neuroprotective benefits in this population

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### **Trevo Real World Registry Results: Lessons Learned in Stroke Intervention**

*Vezenadaroglu, Erol, MD*

#### Objective:

The Trevo Registry was designed to assess real world outcomes of the Trevo stent Retriever in patients experiencing ischemic stroke from large vessel occlusion (LVO) performed in real world experience.. It is the largest prospective study for acute stroke intervention to date, with 2010 patients enrolled and 90-day outcomes in 1873 patients. The primary endpoint is revascularization status based on post-procedure TIC1 score and secondary endpoints include 90-day mRS, 90-day mortality, neurological deterioration at 24 hours and device/procedure related adverse events.

#### Methods:

The study was a prospective, open-label, consecutive enrollment, multi-center, international registry of patients who underwent mechanical thrombectomy for acute stroke using the Trevo stent retriever as the initial device in real world setting.

#### Results:

The median NIHSS at admission was 16 (IQR 11-20). Most patients (70.8%) were treated at <= 6 hours from

last known normal with a median procedure time of 50 minutes (32-77). The occlusion site was M1 or M2 in 73.9%. General anesthesia was employed in 43.5% of procedures. TICI 2b or 3 revascularization was 92.8% with an average of 1.7 passes with the device. Median NIHSS at 24 hours and discharge was 6 and 4 respectively. Fifty-five percent (55.2%) of patients had mRS  $\leq 2$  at 3 months and the overall mortality rate was 13.8%. Patients treated after 8 hours of symptom onset had a 95% revascularization rate and 51.2% mRS  $\leq 2$  at 3 months. The symptomatic ICH rate was 1.6%. Patients who met the revised AHA criteria for thrombectomy were found to have 59.5% mRS 0-2 at 90 days.

#### Conclusions :

The Trevo Retriever Registry represents the largest and first real world data with stent retriever use in the era of clinical trials showing the overwhelming benefit of stent retrievers to treat acute ischemic stroke. Since this data represents real world use of the Trevo Retriever, (e.g. subjects pre-stroke mRS  $> 1$  (29%) and those treated 6-24 hours after stroke symptoms (29%), this data cannot be compared to the results from recent trials with restricted eligibility criteria. The resultant outcomes at 90 days and the procedures being done in a non controlled real world experience corroborate earlier studies showing both safety and efficacy. Future subgroup analysis of this large cohort will help to identify areas of future research to enhance outcomes further with this treatment modality.

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### **An Argument for Neurogenic Induced Severe Apnea as the Potential Initiating Event in Sudden Death or Cardiopulmonary Arrest Following SAH. An Experimental Study and Review of the Literature**

***Britz, Gavin, MD***

#### Abstract:

Aneurysmal SAH is still associated with a significant mortality and morbidity. One of the reasons is there has not been much improvement in the ultra-early outcome following an SAH. This includes the pre hospital and early admission cohort of patients. Without this knowledge further improvements in this disease will be affected. It is well known that an Aneurysmal SAH is commonly associated with a cardiopulmonary arrest and a transient loss of consciousness and the most accepted theory is that a significant brain stem injury is the cause. We hypothesize that a neurogenic induced severe apnea is the precipitating event.

#### Methods:

Studies were performed in 79 10-14 weeks old male C56BL/6J mice (Jackson Labs). Anesthesia was initiated and core body temperature was maintained at 37°C. To induce SAH conventional monofilament perforation of the Willis circle was employed. The hemorrhage was scored. Electrocardiogram and respiration was recorded as well as respiratory movements. ICP was monitored with the TMikro-Tip™ Pressure catheter. For regional cerebral blood flow (rCBF) measurement, needle probe (1.5 mm diameter, Moor Instruments, Wilmington, DE) fixed to the stereotaxic holder was placed over the intact skull. Arterial pressure was monitored through the catheter. Intraventricular injection of capsazepine (Czp) or aCSF was performed using stainless steel tubing introduced through the small burr hole.

#### Results:

Immediately following the perforation ipsilateral rCBF dropped by  $75 \pm 15\%$  ( $p < 0.01$ ), AP increased by  $8 \pm 2\%$  (from  $97 \pm 8$  to  $104 \pm 11$  mmHg,  $p < 0.05$ ), ICP transiently increased by  $102 \pm 12\%$  (from  $6 \pm 2$  to  $24 \pm 5$  mmHg,  $p < 0.01$ ), and HR increased by  $6 \pm 3\%$  (from  $621 \pm 23$  to  $658 \pm 35$  beats/min,  $p < 0.05$ ). Immediately following the perforation, 95% of all animals (117 out of 123) demonstrated dramatic decrease in RR by  $69 \pm 12\%$ , from  $0.9 \pm 0.1$  to  $0.2 \pm 0.2$  breaths/sec,  $p < 0.01$ , which progressed to apnea in 73% of cases. No correlation between the SAH score and RR suppression was observed (Spearman correlation 0.321,  $p > 0.5$ ). Czp failed to modify baseline parameters and acute autonomic responses to SAH.

#### Conclusion:

Data reveal severe respiratory abnormalities in response to SAH. Very short latency of the apneic response and its independence from the size of the hemorrhage strongly suggest neurogenic origin of apnea. Failure of Czp to modify respiratory and other autonomic responses to SAH evidences against involvement of TRPV1 channels. Our data suggest that acute respiratory dysfunction following the ictus could be causative of the high mortality following SAH.

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## **Deep Brain Stimulation for treatment refractory obesity**

*Tronnier, Volker, MD*

Obesity can be considered a pandemic with a rising prevalence. By the year of 2030, more than two-thirds of the inhabitants of the Western world will likely be overweight (body mass index (BMI) >25 kg/m<sup>2</sup>) with one-third being obese (BMI>30 kg/m<sup>2</sup>). Treatment approaches consist of behavioural and pharmacological approaches, however, these are often found to be ineffective. In severe obesity, bariatric surgery is frequently performed. Unfortunately, 40% of patients show substantial weight gain over the long term or display the associated metabolic syndrome, making the development of novel therapies necessary.

Deep brain stimulation is considered a treatment option for refractory cases. Some authors focus on modulation of the homeostasis, targeting directly the lateral nucleus or ventral medial hypothalamic nucleus as an homeostatic center of eating (Whiting et al. 2013), others focus on the ventral striatum or the nucleus accumbens (NAcc) to reduce binge eating and creating weight loss (hedonic center of eating).

We started a recent project targeting the nucleus accumbens after observation of weight loss of about 120pds in a lady originally treated for depression in the NAcc. A second patient is treated with obesity without any accompanying psychiatric disorder after gastric bending and several behavioural therapies. The possible mechanisms will be presented as well as the hypothesis of obesity put into the context of the incentive sensitization theory advocated by Robinson and Berridge (1993), which can be influenced by modulation of the brain-reward mechanisms by NaCC DBS.

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## **The Development of a Precision Medicine Approach to ALS**

*Boulis, Nicholas, MD*

Introduction:

Advancements in genomics, proteomics, and transcriptomics has created the potential to understand human diseases at the level of the individual as opposed to population based studies. The attempt to develop tailored therapies based on these individual characteristics has been termed Precision Medicine. With generous funding from a single high net worth individual with Amyotrophic Lateral Sclerosis (ALS), we have attempted to identify the individual features of his disease, in an attempt to discover potential novel therapies targeting his unique pathology.

Methods:

Whole genome sequencing performed on the patient and his parents revealed a limited set of gene variants relevant to neural function. The most promising of these gene variants were subjected to a battery of experiments to evaluate if we could uncover a phenotype at the cellular level including models expressing the mutated gene as well as the patient iPSC derived motoneurons. The gene function was also assessed in a newly created Drosophila model expressing the human wildtype or mutant gene. Separately, we conducted an in silico virtual drug screen, based on the reversal of gene pathways modifications analyzed from transcriptomics data generated from the patient's fibroblasts versus control fibroblasts. In addition, we are currently identifying FDA and European approved compounds able to mitigate cellular dysfunctions induced by the gene variant, using a newly developed high throughput drug screening assay. Further, an unbiased screening of candidate FDA approved drugs able to improve the survival of the patients motoneurons is also underway. Finally, we have obtained longitudinal blood and CSF samples for biomarker analysis in the patient.

Results:

Whole genome sequencing revealed a maternally inherited variant of unknown significance in the X-linked ATP7A gene, a copper transporting P-type ATPase known to chaperones copper to proteins in the trans-Golgi apparatus and export excess copper at the plasma membrane. We found that the mutant ATP7A protein was abnormally trafficked in the patients' motoneurons and induced several other intracellular deficits. In addition, larvae from the mutant fly model expressing the mutant ATP7A protein revealed a motor dysfunction phenotype, indicating that this mutation might participate in the patient's disease. Ongoing high throughput screens based on correction of cellular deficits induced by the patient ATP7A mutation, have already identified new candidate drugs for our patient.

Conclusion:

We have developed a rational and successful approach to Precision Medicine in ALS patients. We identified a potential gene variant contributing to disease, initiated both targeted and unbiased drug screens, and can track biomarkers in patient derived biofluids to monitor disease progression and the impact of any therapy.

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## **USC Epilepsy Consortium - Creation of a Patient-Centered Ecosystem for Epilepsy Care**

*Liu, Charles, MD*

Epilepsy is the third common neurological disorder world-wide and impacts a large number of patients in Southern California. Approximately 2/3 of epilepsy patients are easily managed on anti-epileptic medications alone. However, there remains a large number of patients that face tremendous challenges from the medical, psychological, and socio-economic burdens of persistent seizures. Over the past decade, tremendous advances in epilepsy diagnostic and therapeutic strategies are evident, including numerous developments that have expanded the surgical options for select patients. The American Academy of Neurology and National Association of Epilepsy Centers (NAEC) recommend that these "medically intractable" epilepsy patients be referred to an epilepsy center, and appropriate patients are offered surgery. In spite of technical advances, very little progress has been made to address issues related to access to epilepsy care across the American healthcare ecosystem that is highly fragmented in siloed delivery venues and models. This results in combined efforts that simply fail to address the public-health dimensions of epilepsy. Over the past years, a unique, timely, and unprecedented patient-centered ecosystem for epilepsy care has been established in Southern California. The USC Epilepsy Consortium ties together over 20% of the NAEC-certified epilepsy centers to allow for all patients to have access to the collective expertise of all the centers of the Consortium irrespective of socio-economic circumstance. The centers include the USC Comprehensive Epilepsy Center, Rancho Los Amigos National Rehabilitation Epilepsy Center, Children's Hospital of Los Angeles, Hoag Epilepsy Center, and Kern Medical Epilepsy Center, which together cover the entire spectrum of American healthcare delivery models, including academic/community/private/public/urban/rural/capitated/fee-for-service. This consortium links the respective hub-and-spokes features of each center in ways not dissimilar to that of airline partnerships, with appropriate overlap for redundancy, as well as maximum overall reach. Furthermore, it represents a "living laboratory" to have visibility on systems-level issues and allow for consideration of innovative solutions that address the access challenges that continue to dominate our present discussions surrounding healthcare.

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## **Epidemiological and Environmental Factors Affecting the incidence and outcomes of neurosurgical procedures in a semirural Montana: Observations leading to changes in practice.**

*Origitano, Thomas, MD*

We are entering an era where determination of disposition of patient care and reimbursement will be adjudicated on value. Value is rudimentary defined as outcome /cost. Over the past 6 years of practice in semi-rural Montana I have made a number of epidemiological and environmental observations which have affected the incidence and outcomes of a number of neurosurgical pathologies and interventions. They included but are not limited to the following:

- 1) Dental health
- 2) Water source
- 3) First Nation Population
- 4) Elevated roads with culverts on each side
- 5) Seat belt use
- 6) Use of Ethanol and Illicit Drugs while driving
- 7) Adventurous Out Door Life Style
- 8) Tourist industry state
- 9) Inadequate rehabilitation programs

These social "co-morbidities" lead to an increase in the occurrence of spinal column fractures, spinal epidural abscesses, discitis, closed and open traumatic brain injuries, and the risk of postoperative wound infection. Coupling these pathologies to a life style and lack of insurance can contribute to poorer outcomes, and increased length of stays. In prior times when the sophistication of health care in the state was less, these patients were traditionally sent to out of state university centers for their tertiary care. With the emergence of advanced and comprehensive tertiary care in the state, and a desire of in state insurers and Medicaid to limit such out sourcing, new additional resource and financial burdens have been imposed on in state medical centers. This paper will discuss the interdependent variables which can influence poorer outcomes.

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## **ChRO-Seq: a new tool to identify RNA sequences associated with glioblastoma cells**

*Lawrence, Chin, MD*

### **Introduction:**

Chromatin run-on sequencing (ChRO-seq) is a newly described technique that uses RNA polymerase complex for identifying nascent RNA sequences such as noncoding RNAs that are associated with malignant transformation and progression in brain tumors. ChRO-seq is more sensitive than RNA-seq and can be used to investigate regulatory elements that are frequent targets for epigenetic modification.

### **Methods:**

ChRO-seq was used to examine 20 fresh frozen GBM specimens, 3 patient-derived xenografts (PDX) and glioma cell lines, and 13 normal brain samples. Genomic analysis was used to map and quantify these nascent RNA species.

### **Results:**

Over 90,000 enhancer RNAs were found in GBM cells with approximately 12% that distinguish normal brain from tumor. Expression patterns allowed tumors to be classified into the four familiar GBM subtypes although several were composed of multiple subtypes. 1343 gene changes were found that distinguish tumor from normal with most related to cell cycle, metabolic processes, and cell development such as HOX and EN1 and 2. Enhancer profiles that may indicate changes in transcription regulatory elements (TRE) show high similarity between tumor cells and normal brain and PDXs, but were dissimilar to glioma cell lines and cultured normal brain. Specifically, these tumor associated TREs cluster in genes related to stem cell regulation, cell differentiation, and immune cells. Notable stem cell motifs seen were POU and SOX as well as differentiated cell support motifs AP1 and HSF.

### **Conclusion:**

ChRO-seq is a powerful new tool that can be used in archived brain tumor samples to provide nascent RNA transcription maps. Unique signatures have been identified that distinguish GBM from normal brain and provide evidence for the importance of stem cell motifs in tumorigenesis.

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## **Connectomic Maps of Large Scale Human Brain Networks and their application to Brain surgery**

*Sughrue, Michael, MD*

Connectomic software and data processing has permitted the analysis of massive datasets of human brain imaging providing unparalleled views into human brain structure and function that were not previously possible. The greatest limitation of the work of others is the lack of anatomic specificity of many studies, which limits the ability to use these in real patients, especially for brain surgery, and as such the penetration of these technologies into neurosurgery has been very limited. In this presentation, we will summarize our efforts to annotate the Human connectome project data and to place this into an anatomically specific framework. Using the building blocks of the HCP parcellation scheme, we have detailed anatomically specific maps of large scale human brain networks such as the default mode and salience networks, as well as networks underlying neuropsychological phenomena such as language, praxis and motor using a combination of functional imaging, DSI tractography, and coordinate based meta-analysis.

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## **Dural Arteriovenous Fistulas**

*Albuquerque, Felipe, MD*

### **Object:**

The rarity of cerebral dural arteriovenous fistulas (dAVF) has precluded analyses of their natural history across large cohorts. A considerable proportion of the few reports that exist have evaluated heterogeneous groups of untreated and partially treated lesions.

### **Methods:**

A multi-institutional database of dAVFs was queried for demographic, angiographic data and untreated natural course. Stratified by Djindjian type, annual nonhemorrhagic neurologic deficit (NHND) and hemorrhage rates were derived along with risk factors for each. Multivariable Cox proportional hazards regression model were used to calculate hazard ratios.

### **Results:**

295 dAVFs had at least one month of untreated follow-up. For 126 type I dAVFs, there were no episodes of NHND or hemorrhage over 177 lesion-years. Annualized NHND and hemorrhage rates were 4.5% and 3.4% for type II, 6.0% and 4.0% for type III, and 4.5% and 9.1% for type IV dAVFs, respectively. Annualized NHND and hemorrhage rates were 2.3% and 2.9% for

type II-IV dAVFs that did not present with NHND or hemorrhage, 23.1% and 3.3% for dAVFs presenting with NHND and 0% and 46.2% for those presenting with hemorrhage, respectively. On multivariate analysis, NHND presentation (HR 11.49, 95% CI 3.19-63) and leptomeningeal venous drainage (HR 5.03, 95% CI 0.42-694) were significant risk factors for NHND; hemorrhagic presentation (HR 17.67, 95% CI 2.99-117) and leptomeningeal venous drainage (HR 10.39, 95% CI 1.11-1384) were significant risk factors for hemorrhage.

#### Conclusion:

All type II-IV dAVFs should be considered for treatment; given the high risk of rebleeding, those presenting with NHND/hemorrhage should be treated expediently.

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### **Carbon fiber components for reconstruction after resection of spine tumors.**

#### *Choi, David, MD*

Carbon fiber is a strong, light and resilient material which has transformed the motor vehicle and sports equipment industries. In the field of spine surgery, the material is becoming more frequently used to reconstruct the spine after tumour resection. Vertebral body replacements and pedicle screws and rods are now available in carbon fiber composite materials, with several advantages over standard titanium components. One significant advantage is the lack of beam perturbation when carbon fiber components are subject to radiation or proton beam therapy. This results in very little scattering or blocking of the radiation beam, and consequently greater accuracy and dose delivery.

Carbon fiber pedicle screws are now being used after primary spine tumor resection for tumors such as chordomas, chondrosarcomas and bone sarcomas. These screws presently have some limitations and the next generation of screws and rods will hopefully be more user friendly, and equal in cost to standard titanium screws.

We present our early experience of carbon fiber pedicle screws for the treatment of primary spine tumors, and describe the benefits, limitations and practicalities of this technology, and suggestions for future development.

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### **The Icon and The Iconoclasts**

#### *Sisti, Michael, MD*

The Gamma Knife is an Icon of radiosurgery. Since the first patient treatment by Leksell in Sweden in 1968 and the first commercial installation in the UK in 1984 nearly one million patients have been treated worldwide in Gamma Knife centers in over 50 countries and over 2800 peer reviewed publications have been published on every aspect of the Gamma Knives operation and use in treating a multitude of conditions of the central nervous system, almost all involving a single radiosurgical treatment in a stereotactic headframe. The introduction of the Icon Gamma Knife system in 2015 introduces the use of a simple method enabling repeatable head immobilization and tracking based on a completely non invasive facial mask application combined with a cone beam CT registration system for treatment planning and administration allowing for the possibility of multifractionated treatments .

The paradigm change of multifractionated treatments with the introduction of Icon Gamma Knife Radiosurgery is likely to lead to the creation of "Gamma Knife Iconoclasts" based upon our first year experience with the Icon system at Columbia.

Eleven neurosurgical users over the last 20 years have preformed more than 5000 single frame based radiosurgery treatments at our center. Since the installation of the Icon upgrade in April of 2017 to Jan 2018(9.5 months total) of use 300 unique patients have been treated in a total of 483 treatment sessions. Among these 300 patients are 84 patients who underwent masked mask based treatments in 267 fractions (average 3.18 fractions per patient ranging from 1 to 5 treatment sessions).

This preliminary report will describe and illustrate some of the conditions, observations and methodologies for novel Gamma Knife multifractionated treatments not readily achievable with single fraction frame based treatments based upon our previous experiences. The pros and cons of single versus multifractionated treatments will be highlighted based upon our initial Icon experience along with the inevitable controversies that are likely to emerge when new paradigms are introduced into the established order of the traditional Gamma Knife treatments of the last 30 years.

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## The Development of an Endovascular CSF Shunt

*Heilman, Carl, MD*

### Introduction:

There has been minimal progress in the treatment of communicating hydrocephalus over the last 50 years. We sought to develop a novel approach for the treatment of communicating hydrocephalus that would replace the function of arachnoid granulations.

### Methodology:

A patent was obtained for the placement of an endovascular CSF shunt device into the wall of the sigmoid sinus. A company, CereVasc LLC, was formed to develop an endovascular CSF shunt (eShunt) that could be delivered via a transfemoral venous approach to establish a one way path for CSF drainage.

### Results:

Analysis of cisternal anatomy around the lateral cerebellum on thin slice axial MRI images in 36 patients aged 20 – 80 years revealed a larger CSF volume in the CP angle cistern immediately adjacent to the inferior petrosal sinus (IPS) than next to the sigmoid sinus. 3-D printed high resolution models were generated based on patient-based MRI anatomy of the IPS and CP angle cisterns incorporating a dural substitute membrane. These enabled rapid development of multiple eShunt prototypes that could be delivered on benchtop through a 3 French catheter into the IPS and penetrate the sinus wall into the CP angle cistern, thus establishing a CSF venous shunt. Design of the eShunt prototypes was further refined by deployment into the IPS and CP angle cistern in 16 cadaver head specimens in the angiography suite using biplane and 3D fluoroscopic imaging and conventional endovascular tools. Additional work was performed on valve design, device coatings, and blood flow loops to mitigate clotting. A presubmission meeting was held with the FDA and work on an eShunt “First in Human” trial is underway.

### Conclusion:

The development of a minimally invasive CSF shunt inserted through a transfemoral endovascular approach in the Neuroendovascular suite offers a novel method for the treatment of communicating hydrocephalus which could possibly revolutionize CSF diversion care. The development of an eShunt system has moved beyond the proof of principle to a prototype stage and plans are being made for a first in human trial.

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## The relationship between surgical site drains and reoperation for wound-related complications following posterior cervical spine surgery: a multicenter retrospective study of 1,799 patients

*Riesenburger, Ron, MD*

### Introduction:

Objective: Use of surgical site drains following posterior cervical spine surgery is variable, and its impact on outcomes remains controversial. Studies of drain use in the lumbar spine suggest drains are not associated with reduction of reoperations for wound infection or hematoma. There is a paucity of studies examining this relationship in the cervical spine where hematomas and infections can have severe consequences. This study aims to study the relationship between surgical site drains and reoperation for wound-related complications following posterior cervical spine surgery.

### Methods:

This study is a multicenter retrospective review of 1,799 consecutive patients undergoing posterior cervical decompression with instrumentation at four tertiary care centers treated between 2004-2016. Demographic and perioperative data were analyzed for associations with drain placement and return to the operating room.

### Results:

Of 1,799 patients, 1,180 (65.6%) had a drain placed. Multivariate logistic regression analysis identified history of diabetes (OR 1.37, P=0.03) and total number of levels operated (OR 1.32, P<0.001) as independent predictors of drain placement. Rates of reoperation for any surgical site complication were not different between the drain and no-drain groups (4.07% vs. 3.88%, P=0.85). Similarly, rates of reoperation for surgical site infection (1.61% vs. 2.58%, P=0.16) or hematoma (0.68% vs. 0.48%, P=0.62) were not different between the drain and no-drain groups. However, after adjusting for history of diabetes and the number of operative levels, patients with drains had significantly lower odds of returning to the operating room for surgical site infection (OR 0.48, P=0.04) but not for hematoma (OR 1.22, P=0.77).

### Conclusions:

This large study characterizes current practice patterns in the utilization of surgical site drains during posterior cervical decompression and instrumentation. Patients with drains placed did not have lower odds of returning to the operating room for postoperative hematoma. However, our data suggests patients with drains may be less likely to return to the operating room for surgical

site infection though the absolute number of infections in the entire population was small limiting the analysis..

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## **ACS NSQIP Surgical Risk Calculator Accurately Predicts Risk for Increased Hospital Cost in Neurosurgical Patients**

**Hoh, Daniel, MD**

### **Introduction:**

The American College of Surgeons (ACS) National Surgical Quality Improvement Program (NSQIP) online Surgical Risk Calculator uses inherent patient characteristics to provide predictive risk scores for adverse postoperative events. The purpose of our study is to determine if patients with a high predicted risk score are associated with increased in-hospital costs.

### **Methods:**

A single-center retrospective review of 1006 neurosurgical patients treated in the period from September 2011 through December 2014 was performed. Individual patient characteristics were entered into the NSQIP calculator. Predicted risk scores were compared with actual in-hospital costs obtained from a billing database. Statistical models were used to determine if patients with higher risk scores were associated with increased in-hospital costs.

### **Results:**

We used the Pearson correlation coefficient (R) to assess correlation between 11 types of complication risk scores and 5 types of encounter costs from 1006 UF health encounters involving neurosurgical procedures. Risk scores in categories such as serious complication, any complication, pneumonia, cardiac complication, surgical site infection, urinary tract infection, venous thromboembolism, renal failure, return to operating room, death, and discharge to nursing home or rehab were examined. Patients with higher risk scores in all measures except surgical site infection were found to have a statistically significant association with increased in-hospital costs ( $p < 0.001$ ).

### **Conclusion:**

Previous work has demonstrated that the ACS NSQIP Surgical Risk Calculator can accurately predict mortality but is poorly predictive of other potential adverse events and clinical outcomes. However, this study demonstrates that high-risk patients identified by the ACS NSQIP Surgical Risk Calculator have a statistically significant association with an increase in-hospital cost. The NSQIP calculator may not accurately predict surgical risk (as demonstrated previously), given the

current healthcare climate future iterations of the ACS Universal Risk Calculator may be a valuable tool in predicting in-hospital costs

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## **Salvage Treatment for Locally and Systemically Recurrent Skull Base Chordomas**

**Shaan, Raza, MD**

(Sponsored by Ian McCutcheon to submit an abstract)  
Salvage Treatment of Locally and Systemically Recurrent Skull Base Chordomas

### **Authors:**

Shaan M. Raza MD1, Diana Bell MD2, Jacob L. Freeman MD1, David R. Grosshans MD PhD3, Gregory N Fuller MD PhD2, Franco DeMonte MD1

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**BACKGROUND:** Limited data exists to guide the management of recurrent chordomas arising in the skull base.

### **Objective:**

This study was performed to determine factors affecting tumor control rates and disease-specific survival in recurrent disease.

### **Methods:**

A retrospective review was performed of 29 patients with 55 recurrences treated at our institution. Tumor and treatment factors were assessed for impact on 'freedom from disease progression' (FFP; primary outcome) and 'disease-specific survival' (DSS; secondary outcome).

### **Results:**

Post-radiotherapy disease failure was much more difficult to manage versus progression after surgery alone (15.9 v 41.4 months,  $p=.094$ ). Distant metastases and, specifically, LMD at presentation was associated with poorer DSS and FFP ( $p<.05$ ). For local progression after surgery alone, repeat resection ( $p<.05$ ) improved median FFP. With post-radiotherapy local failure, repeat resection along did not confer any benefit (13.5 vs. 17.6 months,  $p>.05$ ) while a trend towards improved FFP was seen with SRS (28.3 vs. 16.2 months,  $p=.233$ ). However, a palliative role for SRS with or without preceding surgical resection was noted for post-proton therapy local progression ( $p<.05$ ). For distant metastases, site

directed therapy (surgery or radiation) allowed for site control for treated sites ( $p < .05$ ) but did not affect FFP or DSS. Presentation with early progression  $< 6$  months from previous treatment portended significantly worse DSS (19.3 vs. 77.6 months,  $p < .05$ ).

**Conclusion:**

There is a need for treatment of recurrent disease to be tailored to the pattern of tumor recurrence and previously received treatments. Post-radiotherapy progression poses particular challenges given the apparent limited role of repeat resection alone. SRS may have a role in this setting when combined with the judicious use of repeat surgical resection. While patients with systemic metastases appear to respond well to site directed therapy, those with LMD have a dismal prognosis.

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**Cervical Traction for the Treatment of Unstable Subaxial Injuries**

*Huang, Jason, MD*

Following acute cervical spine trauma, traction can be used to restore sagittal plane alignment in patients with subaxial injuries. Furthermore, it can reduce unilateral or bilateral cervical facet dislocations, and to improve alignment in patients with traumatic spondylolisthesis of the axis. We here report our institutional experience treating both adult and pediatric patients with acute unstable cervical spinal trauma using skull traction +/- surgical stabilization. Our experience suggests that the use of cervical traction may obviate the need for operative treatment for some patients with atlanto-axial rotatory subluxation. Additionally, our use of perioperative and intraoperative spinal traction has been shown to assist with preoperative planning and to improve overall correction and pulmonary function in patients with spinal deformity. Our data suggest that the most common complications associated with cervical spine traction include pin-site infection, pain and neuroma formation; however, more serious neurological complications, including cranial nerve palsy and spinal cord injury, although rare, could also occur; thus, careful monitoring of patients undergoing traction is essential. A review of the literature is provided.

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**Outcome of Combined Endovascular and Surgical Treatment of Unruptured Anterior Communicating Artery Aneurysms: Should More Aggressive Treatment Be Offered?**

*Ogilvy, Christopher, MD*

**Introduction:**

Natural history studies show anterior communicating artery aneurysms have a higher risk of rupture than other anterior circulation lesions, yet treatment of small unruptured aneurysms remains controversial. As treatment improves, risk may fall to levels which justify intervention for these aneurysms. With low treatment risk and a nuanced understanding of lesion risk, an aggressive treatment strategy may be justified.

**Methods:**

149 patients with unruptured aneurysms of the anterior communicating artery were treated by the senior authors over a five-year period. Treatment was performed by operators trained both in endovascular and surgical techniques. Treatment method was based on an estimate of lowest risk/highest efficacy for each patient. Outcomes were recorded at three months and one year from treatment. The primary outcome was defined as a modified Rankin score (mRS) of  $> 2$  or persistent cognitive impairment.

**Results:**

Age averaged 61, range 34-84 years. Aneurysm size averaged 6 mm, range 2-15 mm. 79% of aneurysms measured 7 mm or less. Clipping was performed in 98 patients (65.8%). Patients aged  $> 60$  years were more likely to be treated endovascularly (33/76, OR=2.55; 95% CI 1.26-5.14,  $p=0.0089$ ). The primary outcome was met in 12 patients (8%). Of all poor outcomes, 11/12 occurred in patients  $> 60$ . Size or treatment method did not predict poor outcome. Age  $> 60$  was the most significant predictor of poor outcome with a nearly 13-fold increased risk for older patients (OR=12.9; 95% CI 1.62-102.9,  $p=0.016$ ). Only one patient under 60 had a poor outcome (cognitive dysfunction, 1.36%). No patient under 60 had an mRS  $> 1$ .

**Conclusions:**

The risk of treatment of unruptured anterior communicating artery aneurysms for patients under age 60 is low. Comparing treatment risk to natural history studies, a patient treated under age 60 will outperform natural history within one to two years. Recognizing the lower risk of treatment for smaller anterior communicating artery aneurysms, an aggressive management strategy is supported.

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## Vein of Galen Malformation

*Kan, Peter, MD*

### Introduction:

Vein of Galen malformations comprise nearly a third of pediatric vascular anomalies, with potentially devastating neurologic and cardiac complications. While neurosurgeons have always been a critical part of the treatment team, advances in endovascular treatment have improved the clinical outcomes of these high-risk patients. Here we present lessons learned from the 15-year experience at Texas Children's Hospital in treating children with modern endovascular techniques.

### Methods:

Charts from TCH were retrospectively reviewed for the past 15 years. Patients with diagnosis including 'Vein of Galen,' 'Vein of Galen malformation,' 'Vein of Galen aneurysmal malformation,' or any abbreviations (ie VOG, VOGM, VOGAM) were reviewed. Presentation, imaging, treatment specifics, and clinical outcomes were reported.

### Results:

There were 17 patients with Vein of Galen malformations managed at TCH from 2002-present with a total of 27 embolizations. Of the 27 embolizations, 12 were performed with NBCA only, 4 with onyx only, and 11 with a combination of NBCA/Onyx/coils. A dual lumen balloon was used as an adjunct in three embolizations for flow arrest during onyx injection. Complications occurred in four embolizations: one intraventricular hemorrhage leading to death, one subarachnoid hemorrhage (asymptomatic), two with embolus migration with no sequelae. Two embolizations were terminated due to patient hemodynamic instability. Surviving patients were followed for a mean of 38 months. Seven patients had normal development, while five had developmental delay but continue to make progress.

### Conclusions:

Vein of Galen malformations can present with a myriad of neurologic and systemic symptoms, potentially in extremis. Neurosurgical involvement in these cases is critical, as urgent treatment can be lifesaving. Modern endovascular interventions have improved outcomes in this high-risk population, and patients can go on to have normal development or only slight deficits. Additional data is needed to determine if type of malformation, presenting symptom, or degree of embolization affects prognosis.

## Current MCA Aneurysm Treatment- single institution experience

*Mrak, Goran, MD*

Mrak G, Nemir J, Brgic K, Paladino J, Desnica A, Lupret V

Department of neurosurgery, University Clinical Centre Zagreb, Medical School Zagreb, Croatia, Europe

### Introduction:

The best treatment for the MCA aneurysms remains unclear. Endovascular technique has replaced surgery for all aneurysm locations except MCA, where clinical status of the patients for unruptured aneurysms seems the same, but surgical treatment has still some advantages. We have analyzed our series of patients to contribute to the proper decision making in the treatment selection of the MCA aneurysms.

### Patients and Methods:

From 2002 to 2017 at the Department for neurosurgery, University Clinical Centre Zagreb 595 MCA aneurysms in 538 patients were surgically treated. Since introduction of endovascular aneurysm treatment at the Hospital, the proportion of MCA aneurysms left for surgical treatment increased to 50% of the whole surgical group of patients, and comprises around 40 MCA cases per year in average.

There were 59,1% unruptured aneurysms, and 41,9% of ruptured cases. In ruptured cases presentation were as follows: HH1: 42%; HH2: 24,4%, HH3: 15,8%; HH4:6,7%. 88,1% of cases were treated within 72 hours, and 11,9% were delayed surgeries. In recent years, majority of patients are treated immediately after diagnosis, but for the health care service organization reasons, some patients came later for the treatment. 93,7% of aneurysms were directly clipped, 4,2% of cases were reconstructed with clip and previous thrombectomy, and in 0,63% bypass was performed. In 1,4% of cases wrapping was the the treatment option.

### Results:

In our series of patients 81% of surgically treated group were mRS 0-2, with better results in unruptured group of patients (88% mRS 0-2), than in ruptured group (74%). In unruptured group of patients in 5,7% of cases clinical status was worse than before surgery, while in ruptured aneurysm group 15,8% of cases were worse than initially at presentation.

In endovascular group of patients 78,2% of patients

were mRS 0-2, with 85% in unruptured patients, and 73% in ruptured patients.

#### Conclusion:

Despite the fact that overall clinical results in both groups of patients were similar, surgical treatment for MCA aneurysms has some advantages and wider armamentarium of treatment techniques specially in complex aneurysm cases. Previous series confirmed higher complete occlusion rate, and less recanalisation rate, with fewer thromboembolic complication rates in surgically treated cases which gives credit for further surgical treatment of MCA aneurysms.

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### **Delayed clearance and perivascular stasis of macromolecules as a pathognomonic feature of hydrocephalus: An experimental study.**

*Krishnamurthy, Satish, MD*

#### Introduction:

Pathogenesis of hydrocephalus is not clearly understood. Brain is permeable to water due to the presence of aquaporin channels and we have previously shown that infusion of hyperosmolar dextrans into the ventricles is sufficient to cause hydrocephalus in rats. Therefore, water influx into the ventricles is secondary to the presence of macromolecules in the ventricles. Our previous study showed that macromolecules infused into the ventricles were distributed widely in the brain parenchyma especially in the perivascular region and cleared into the blood. The present study was to determine the rate limiting step in the transport of macromolecules out of the ventricles.

#### Methods:

Three different models of hydrocephalus were used to study macromolecular transport out of the ventricles. Two rat models of kaolin induced hydrocephalus (cisterna magna "obstructive" and basal cistern "communicating") and a genetic mouse model POMGNT1 were used. In all these animals, transport of FITC labeled dextran at different time points following intraventricular injection was compared to normal animals. In the case of genetic mouse model, the knock-out mice were compared to the wild type. Histopathology was used to determine the distribution of the FITC dextran.

#### Results:

In the rat models of hydrocephalus, there was a significant delay in the clearance of iron labeled dextrans from the ventricles compared to normal (figure 1). Upon sacrifice and histopathological examination of

the tissues under fluorescent microscope, the tagged dextrans were found to accumulate significantly in the perivascular compartment in all the models of hydrocephalus that were examined (figures 2 and 3). This suggests that there is perivascular stasis.

#### Conclusions:

Presence of hydrocephalus is associated with a significant delay in the clearance of macromolecular marker from the ventricles. This delay appears to be in the transfer of macromolecules from the brain into the blood as evidenced by perivascular stasis. Understanding the underlying mechanisms of macromolecular transport out of the brain into the blood such as exocytosis and/or efflux transport will pave the way for pharmacological treatment of hydrocephalus.

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### **Laser Interstitial Thermotherapy for Spinal Metastatic Disease Provides, Reduced Morbidity and Less Delay to Systemic Therapy Compared to Open Surgery**

*Tatsui, Claudio, MD*

#### Introduction:

The proximity of the spinal cord to the epidural space limits radiosurgical dosing to compressive metastatic lesions in the spinal canal. Open surgery is used to create a safe margin around the spinal cord prior to spinal stereotactic radiosurgery (SSRS) but harbors potential surgical morbidity and interruption of systemic oncologic treatment in the post-operative period. Spinal laser interstitial thermotherapy (SLITT) in conjunction to SSRS, can provide local control with less morbidity and shorter interval to resume systemic treatment than conventional surgery. Here, we compared SLITT to open surgery to determine the advantages and disadvantages of each.

#### Methods:

161 patients with MESCC treated with open surgery (n=84) and SLITT (n=77) during a similar time period were selected for study. Medical records and imaging studies were analyzed. Demographics, anatomic location, ESCC scores, histology, morbidity, hospital LOS, days until further treatment, local control and overall survival were retrospectively compared.

#### Results:

Patient demographics and clinical characteristics were similar, except the extent of pre-op ESCC was higher in the surgery group. Compared to open surgery, SLITT was associated with smaller post-operative decrease

in extent of ESCC (1.25 vs 3.2<0.0001), but lower EBL (<100cc vs 1186cc p<0.0001) shorter hospital stay (3.42 days vs 12.1 days p<0.0001), a lower rate of morbidity (12.7 vs 28.6% p=0.021), fewer days until treatment with XRT/SRS (9.4 vs 40.2 p>0.0001) and systemic treatment (27.3 days vs 62.8 days p<0.0001). 1-year local control and overall survival were similar between groups (PFS-6: 79.5 SLITT vs 72.1 open p=.857, Median OS: 517 vs 562 days p=0.839)

#### Conclusion:

Compared with open surgery, SLITT offers adequate local control with less morbidity, shorter hospitalization and faster return to oncologic treatment. A randomized controlled study may be warranted to demonstrate superiority of SLITT to open decompressive surgery for ESCC.

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### **Transnasal Endoscopic Skull Base Approaches in Children: A Single Institution Experience.**

*Levy, Michael, MD*

As surgeons/institutions become more adept at endoscopic skull base approaches, the number of pediatric cases is rapidly increasing. Differences in pathology, anatomy, and potential complications can be significant between these populations. We will discuss our current experience and compare such with current adult series. In our experience significant variables which can impact outcome include Center Expertise, Surgeon Expertise, Understanding of Anatomic Variation in Children, and Staging.

#### Methods:

A prospective evaluation was done on pediatric patients up to age 10 who underwent EEA skull base resections from June 2014 to December 2016 at our institution. IRB approval was obtained from the UCSD IRB committee.

#### Results:

27 children underwent an EEA for skull base tumors. Patient age ranged from 1 to 10 years of age (mean 5.5 years old). Tumor pathology included; 8 craniopharyngiomas, 8 pituitary adenomas, 4 Rathke cleft cysts, 1 encephalocele, 1 hamartoma, 2 chordomas, 1 dermoid cyst, 1 neuroblastoma, and 1 unknown. Complications included stroke in 1 patient and 17 intraoperative CSF leaks. In our series there were 8 'high-flow leaks', 9 'low-flow leaks', and 10 cases with 'no leak'. 20 cases were repaired without a NSF, 7 'high-flow leaks' were repaired with NSF, and 1 'high-flow leak' was not repaired with NSF. Postoperative CSF leaks were observed in any patients.

#### Conclusions:

We conclude that significant differences may exist between Pediatric and Adult populations undergoing endoscopic skull base approaches. We will discuss the anatomic variations, likely complications, need for staging of procedures in younger children, and appropriate training levels that we believe are useful given our limited experience.

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### **The evolving neurosurgery paradigm for Tuberous Sclerosis Complex**

*Weiner, Howard, MD*

#### Introduction:

Tuberous Sclerosis Complex (TSC) is a genetic condition associated severe medically refractory epilepsy in early childhood, which can lead to developmental delay. Epilepsy surgery is an effective treatment in select patients. We have cared for over 100 TSC children with a traditional approach (TA), consisting of craniotomy for grid followed by resection. Given the natural history of TSC, and the new concept of palliative epilepsy surgery, we developed a minimally invasive approach (MIA) as an option. Our aim is to report the early experience with this novel treatment paradigm.

#### Methods:

Over the last 21 months, since May 2016, we have operated on 23 children with TSC (12 female, 11 male; mean age 3.96 years) and medically refractory epilepsy. All patients underwent a Phase I evaluation, consisting of VEEG, MRI, CT, MEG, PET and group discussion at epilepsy conference, where the collective decision was made for either MIA with stereo EEG (SEEG) and stereotactic laser ablation (SLA) or TA. Surgery was targeted to the most symptomatic seizure type.

#### Results:

17 children underwent MIA (SEEG plus SLA) and 6 had TA. 9 of the 17 MIA patients had prior TA surgery, compared to 2 of the 6 TA patients. At early follow up, 11 of 16 MIA and 4 of 6 TA patients were significantly improved with respect to the targeted seizure type; 1 MIA patient subsequently had TA surgery after seizure recurrence and is improved. Complications included one hemorrhage seen on MRI, not requiring treatment, one post-ablation edema treated with steroids, and one superficial SEEG bolt skin infection treated with antibiotics. MIA patients were discharged 2 days post-treatment on average.



## Conclusion:

Early results support the notion that minimally invasive approaches may be an effective option for young children with TSC and refractory epilepsy, in addition to the traditional approach of craniotomy for grid and subsequent resection. Children with TSC can significantly improve after surgery, despite not being seizure free by definition. This evolving neurosurgery paradigm will play a growing role in palliative epilepsy surgery for TSC.

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## Spine

### *Park, Paul, MD*

#### Objective:

Readmission to the hospital negatively impacts the patient experience and is very costly. To date, most studies have evaluated 30-day readmissions after spine surgery. Evaluation of the 90-day period, however, allows a more comprehensive assessment of factors associated with readmission. The purpose of this study is to assess the reasons and risk factors for 90-day readmissions after lumbar fusion surgery.

#### Methods:

The Michigan Spine Surgery Improvement Collaborative (MSSIC) registry is a prospective, multi-center, and spine-specific database of patients surgically treated for degenerative disease. Data from the MSSIC registry was retrospectively analyzed. Causes for readmission were determined and independent risk factors impacting readmission were found by multivariate logistic regression.

#### Results:

A total of 10,204 patients who underwent lumbar fusion were identified. Nine hundred fifteen (9.0%) patients were readmitted within the 90-day period. The most common specified reasons for readmission were pain (17%), surgical site infection (16%), and radicular symptoms (10%). Risk factors associated with increased likelihood of readmission were other race (OR 1.81, CI 1.01-2.24), CAD (OR 1.57, CI 1.25-1.96), 4 or more fused levels (OR 1.41, CI 1.06-1.88), diabetes (OR 1.34, CI 1.10-1.63), and surgery length (OR 1.09, CI 1.03-1.16). Factors associated with decreased risk of readmission were discharge to home (OR 0.63, CI 0.51-0.78), private insurance (OR 0.79, CI 0.65-0.97), ambulation same day of surgery (OR 0.81, CI 0.67-0.97), and spondylolisthesis diagnosis (OR 0.82, CI 0.68-0.97).

## Conclusion:

After lumbar fusion surgery, 90-day readmission to the hospital occurred in 9.0% of cases. Among many causes for readmission, the most frequent reasons included pain, wound infection, and radicular symptoms. Increased focus on postoperative pain management in particular may decrease readmissions. Among many factors impacting the likelihood of 90-day readmission, early post-operative ambulation seems to be most easily modifiable. Optimization of pre-existing medical conditions such as CAD and diabetes could also potentially decrease readmission risk.

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## **Quantitative MRA Screening and Submaximal Angioplasty is Cost-Effective for Symptomatic Vertebrobasilar Occlusive Disease**

### *Charbel, Fady, MD*

Authors: Darian Esfahani, Dilip Pandey, Xinjian Du, Linda Rose-Finnell, Fady T. Charbel Colin P. Derdeyn, Sepideh Amin-Hanjani, for the VERiTAS Study Group

#### Introduction:

The Vertebrobasilar Flow Evaluation and Risk of Transient Ischemic Attack and Stroke (VERiTAS) study demonstrated that posterior circulation distal flow status is a robust predictor of vertebrobasilar (VB) stroke risk in patients with symptomatic atherosclerotic VB disease. Flow-compromised high-risk patients may benefit from endovascular procedures, such as submaximal angioplasty, that restore flow. In this study we examine the cost-effectiveness of using quantitative magnetic resonance angiography (qMRA) to identify patients with low VB flow who may benefit from submaximal angioplasty.

#### Methods:

A Markov model was created to estimate the cost-effectiveness of qMRA screening to identify treatable patients with low VB flow from VERiTAS, a prospective, observational clinical trial of 72 patients presenting with posterior circulation transient ischemic attack or stroke. Both a "screening" strategy involving qMRA imaging and submaximal angioplasty for eligible patients and a "no screening" strategy were compared across a 30 year time horizon. The primary outcomes were the average number of quality-adjusted life years (QALY) and lifetime costs. Rates of stroke and death were obtained from VERiTAS data, and disability rates and costs were derived from both VERiTAS and the literature. Sensitivity analyses were performed for all variables, with the periprocedural stroke rate from angioplasty as the primary variable of interest.

**Results:**

At a 6% periprocedural stroke risk, the “screening” strategy saved an average of 0.36 QALYs per patient, and a lifetime cost savings of \$8,346 versus the “no screening” strategy. Amongst patients with low posterior circulation flow suitable for intervention, the benefit was much higher, with an average of 1.485 QALYs saved and a lifetime cost savings of \$28,017. Across the entire cohort, QALY savings were observed at the end of the first year, and economic savings at the end of year five. The benefit of screening declined at higher periprocedural risk, but remained cost-effective above 12%.

**Conclusion:**

qMRA screening and submaximal angioplasty in suitable patients is cost-effective both in terms of QALY and lifetime costs for patients with symptomatic vertebrobasilar occlusive disease. With potential health and economic savings from screening and intervention, a clinical trial examining the peri-procedural risk of submaximal angioplasty is warranted.

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**THE SOCIETY  
OF UNIVERSITY  
NEUROSURGEONS**

# BYLAWS

OF

THE SOCIETY OF UNIVERSITY NEUROSURGEONS, INC

## ARTICLE I

### NAME AND OBJECT

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

Section 2.

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

Vision:

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

Mission:

- a) To improve the exchange of new ideas and scientific disclosures,
- b) To enhance comprehension of global activities, university settings, and specific regional challenges in the academic sector, and
- c) To mentor and direct emerging academic neurosurgeons during the mid-career period.

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

## ARTICLE II

### MEMBERSHIP QUALIFICATIONS

Section 1. The membership of the Society shall be divided into four classes:

- (a) Active
- (b) Senior
- (d) Honorary
- (e) Inactive

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

Section 2. Classification of Membership

(a) ACTIVE. Active members shall be neurological surgeons who are certified by the governing body in their respective countries, and who are engaged in the practice of neurological surgery and/or substantially engaged in research on neurological surgery.

(b) SENIOR. An Active member may, upon request to and approval of the Executive Council, transfer to Senior membership upon attaining the age of sixty-five (65) years or upon retirement from practice of neurological surgery, whichever comes first. Senior members may not vote or hold office (except for the office of Historian), but may serve on Committees; and are not required to pay dues or regularly attend annual meetings.

(c) HONORARY. Honorary members shall be chosen as recognized leaders in the field of neurological sciences. They shall not exceed five (5) in number at any given time. They shall not be required to pay dues or attend annual meetings. They shall not vote or hold office but may serve on committees.

(d) INACTIVE. Inactive members shall be former Active members who by virtue of illness or other reasons can no longer maintain Active membership and are not eligible for any other classification of membership. An Active member may, upon request to and approval of the Executive Council, transfer to Inactive status. An Inactive member may be restored to Active status by request to

and approval of the Executive Council. Inactive members shall not vote, hold office, or serve on Committees. They shall not be required to pay dues or attend annual meetings.

### Section 3. Qualifications for Membership

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

### Section 4. Limitation of Membership

The number of Active members in the Society may be limited upon recommendation of The Executive Council and approval by a majority vote of the Active membership.

## ARTICLE III

### OFFICERS

Section 1. The officers of the Society shall be President, President Elect, Vice-President, and Secretary/Treasurer. The Executive Council shall be composed of the officers, one Active Member-at-Large appointed by the President, and the Immediate Past-President of the Society.

Section 2. The Nominating Committee shall present a slate of proposed officers to be elected for the succeeding year at each annual meeting. Active members present at the meeting may make additional nominations. Election of officers shall be by ballot; the member receiving the largest number of votes cast for that office shall be elected. Officers so elected shall take office at the close of that annual meeting.

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

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

Section 5. The President Elect shall be elected at each annual meeting. He/She shall become President of the Society at the close of the subsequent annual meeting.

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

Section 7. The Secretary/Treasurer shall serve for a term of three (3) years. The Executive Council shall determine at which year the election for Secretary/Treasurer will be held. He/She shall keep records of attendance and minutes of each meeting, read all correspondence to the Society, handle all notices and correspondence of the Society. He/She shall account for the finances of the Society, and collect dues and notify members of delinquent standing. He/She shall receive all applications for membership or guest attendance and forward this information to the Membership Committee at least one (1) month prior to the annual meeting.

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

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

## ARTICLE IV

### MEETINGS

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

Section 2. The annual meeting shall be a three (3)-day scientific program that includes a weekend. The scientific presentations shall be balanced between clinical and investigative topics.

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

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

committees, and adjournment.

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

## ARTICLE V

### CANDIDATES FOR MEMBERSHIP

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

Section 2. No candidate shall be elected to Active membership who has not attended at least two annual meetings as a guest, and presented a scientific paper during at least one of those meetings.

Section 3. Each candidate shall be nominated in writing by a minimum of two (2) Active members to the Secretary/Treasurer at least two (2) months prior to the next annual meeting. The nomination shall include the candidate's curriculum vitae and a statement of his/her present academic and professional status. The completed proposal for membership shall be forwarded to the Membership Committee for consideration. The Membership Committee shall present to the Executive Council their recommendations for new members. On approval of the Executive Council, candidates shall be proposed to the Active Membership by written secret ballot at the annual meeting of the Society. Election of a member requires an affirmative vote of three-fourths (3/4) of the Active members present and voting at the annual meeting.

Section 4. The Membership Committee shall present no more than ten (10) candidates for active membership each year with no requirement of a minimum number to be presented.

Section 5. The Secretary/Treasurer shall notify each candidate elected to membership not earlier than two (2) weeks following the date of his/her election.

Section 6. A candidate who has failed to be elected may be reconsidered at subsequent annual meeting upon written request of three (3) Active members to the Executive Council.

## ARTICLE VI

### DUES

Section 1. All Active members of the Society shall be assessed annual dues, the amount to be determined each year by the Executive Council.

Section 2. Dues are payable in advance for the succeeding year at the time of or immediately following the annual meeting, at the discretion of the Secretary/Treasurer.

## ARTICLE VII

### STATUS OF MEMBERS

Section 1. To maintain membership in good standing, members of all classes must fully abide by the Bylaws of the Society.

Section 2. An Active member shall be suspended when dues or assessments have not been paid for the previous two (2) years. If he/she fails to attend two (2) consecutive annual meetings and does not present an excuse acceptable to the Executive Council, a warning letter will be sent. If an active member fails to attend three (3) consecutive meetings, then his/her membership will be terminated. Termination on the grounds of non-payment or failure to attend does not require a vote of the Active membership.

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

## ARTICLE VIII

### COMMITTEES

Section 1. The Society may have standing and ad hoc committees as determined by the President and the Executive Council. There shall be at least six (6) standing committees: Membership Committee, Nominating Committee, Bylaws Committee, Future Sites Committee, Program Committee, and Senior Advisory Committee.

Section 2. The Membership Committee shall be composed of three (3) members, one (1) to be elected at large each year to serve a term of three (3) years. The senior member of the Committee shall serve as Chairman. This Committee shall review nominations

for new members and present the applications of the most worthy and desirable candidates to the Executive Council. The names of the candidates approved by the Executive Council shall be submitted to a vote by the Active membership at the next annual meeting of the Society.

Section 3. The Executive Council shall serve as the Nominating Committee, with the Immediate Past-President of the Society as Chairman. The duties of the Council shall include the yearly nomination of: President-Elect (1), Vice President (1), Member-at-Large (1), as well as new Members to the following Committees: Membership (1), Future Sites (1), Bylaws (1), and Senior Advisory (1-2).

Section 4. The President taking office at the close of the annual meeting shall appoint the Program Committee for the upcoming year. The new President is an automatic member of the Program Committee. The Chairman of the Committee shall be the Host for the next annual meeting. The Program Committee may invite guests to complement the scientific program of the meeting.

Section 5. The Future Sites Committee shall be composed of three (3) members, one to be elected at large each year to serve a term of three (3) years. The senior member of the Committee shall serve as Chairman. This Committee shall recommend the site of future meetings at least two (2) years in advance.

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

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

## ARTICLE IX

### GUESTS

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

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

Section 3. Individual guests to the annual meeting may be invited by members. The member shall notify the Secretary/Treasurer of the name and address of his/her proposed guest, and the Secretary/Treasurer shall officially invite the guest to the meeting.

## ARTICLE X

### AMENDMENTS

Section 1. Amendments to these Bylaws may be proposed in writing by a member of the Executive Council at any time. The amendment shall be voted on at the subsequent annual meeting. The Secretary/Treasurer shall notify all Active members in writing of the proposed amendment prior to the annual meeting, and such amendment shall require for adoption an affirmative vote of three-fourths (3/4) of the Active members present and voting.

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

## RULES AND REGULATIONS

### OF THE SOCIETY OF UNIVERSITY NEUROSURGEONS, INC.

#### SUBJECT 1

#### MEMBERSHIP

##### Section 1. Candidate Profile

- (a) Candidates should be committed to an academic career.
- (b) Candidates should have sufficient publications that the quality of their academic activity can be evaluated.

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

(d) It is desirable to consider Candidates who have potential for hosting a future SUN meeting.

## Section 2. Membership Process

(a) Candidates must have attended at least one (1) SUN meeting and presented at least one (1) paper to the Society before being recommended for membership.

(b) No voting for membership will occur at the first meeting that the candidate attends as a guest and at which he/she presents a paper to the Society.

(c) The membership process shall be initiated by proposal of the name of the Candidate to the Secretary/Treasurer by two (2) Active members. The candidate shall then complete the membership application form and submit it to the Secretary/Treasurer.

(d) After documentation of the completeness of an application for membership, the Secretary/Treasurer shall forward it to the Chair of the Membership Committee for consideration.

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

(f) At the next regular meeting of the Society, the candidate is brought forward for a vote during the Business Meeting.

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

# Exhibitors

## Gold

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**Joimax**  
**Penumbra**  
**Zeiss**

## Silver

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**Spineology**  
**Leica and Select Surgical**  
**Medtronic**  
**Baxter**



American  
Association of  
Neurological  
Surgeons

Jointly Provided by the AANS



THE SOCIETY  
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