



# THE SOCIETY OF UNIVERSITY NEUROSURGEONS

Prague, Czech Republic

2022  
ANNUAL MEETING  
June 29th-July 3rd, 2022



American  
Association of  
Neurological  
Surgeons

Jointly Provided by the AANS

# Prague, Czech Republic

Welcome to Prague for SUN 2022

It is my highest honor and privilege to invite you to magical and ancient Prague, the capital of the Czech Republic, for the Society of University Neurosurgeons Annual Meeting, being held Wednesday June 29th through Sunday July 3rd, 2022. Prague is located in the heart of Europe on the Vltava River and the SUN meeting will take place at the Grand Mark and the Hilton Hotels, both conveniently located right in the historical center of the city.

Members of the SUN and their guests will enjoy a valuable scientific program, similarly to previous successful meetings, which have taken place since 1965. Prague with its cultural and historical values will provide a unique, relaxing and inspiring experience as well as spiritual enlightenment from its rich European history.

The Czech Republic with its capital Prague is an accessible, safe and friendly country. A direct flight from New York takes only 7 hours.

The climate in Prague in June is pleasantly dry, with temperatures oscillating around 65 degrees F during the day, with 16 hours of daily sun (the sun rises at 4:50 and sets at 21:14).

Prague was founded in the 9th century during the Romanesque era and flourished during the Gothic and Renaissance periods. The first university was founded in 1348 by the Czech King Charles IV, who was later crowned emperor of the Holy Roman Empire. In addition to the scientific program, we will have the opportunity to visit and explore many gems of Prague such as St. Vitus Cathedral in Prague Castle, the Jewish Quarter with five synagogues, the Museum of the Art Nouveau painter Alfons Mucha, the Museum of the writer Franz Kafka, as well as the chateau of the composer Antonin Dvorak. We are preparing a gala dinner in the Imperial Hall of the Lobkowitz Palace at Prague Castle with an exquisite view of historic Prague.

The scientist Albert Einstein spent part of his life in Prague. In one of his letters from 1911, he wrote to his friend Bess: "Could you ever visit me? The city of Prague is simply beautiful, so beautiful that it deserves a longer journey in itself."

We cordially invite you to a longer journey to experience the spirit of such a unique city. I wish you good health and I believe in a fruitful and successful SUN meeting 2022 in Prague.

Respectfully,



Martin Sames, M.D.

Professor and Chairman

Vice-President of the Czech Neurosurgical Society



# Present Officers

## President

Felipe Albuquerque, MD

## President-Elect

Ian McCutcheon, MD

## Vice President

Sean Lavine, MD

## Secretary/Treasurer

Richard Anderson, MD

## Historian

Ken Smith, MD

## Member-at-Large

Michael Kaiser, MD

## Membership Committee

Christina Notarianni, MD, Chair

Daniel Hoh, MD

Mandy Binning, MD

## Future Sites Committee

Jeff Sorensen, MD, Chair

Ruth Bristol, MD

Daniel Yoshor, MD

## CME

Carlos David, MD



# 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 Oritano, MD

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

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

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

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

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

~~~~~2018~~~~~  
Michael Wang, MD

~~~~~2019~~~~~  
Richard Ellenbogen, MD

~~~~~2020/2021~~~~~  
Erol Veznedaroglu, MD





# 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

~~~~~2018~~~~~  
MD Anderson Cancer Center  
Houston, TX

~~~~~2019~~~~~  
University of Zagreb, Medical School  
Clinical Hospital Centre Zagreb  
Dubrovnik, Croatia

~~~~~2020~~~~~  
Canceled

~~~~~2021~~~~~  
Whitefish, Montana

# 2022 Meeting Attendees

## SUN Members

Albuquerque, Felipe, MD  
Anderson, Richard, MD  
Baskaya, Mustafa, MD  
Boulis, Nicholas, MD  
Bristol, Ruth, MD  
Camarata, Paul, MD  
Charbel, Fady, MD  
Chin, Lawrence, MD  
Cockroft, Kevin, MD  
David, Carlos, MD  
DeMonte, Franco, MD  
Dogan, Aclan, MD  
Hamad, Farhat, MD  
Kaiser, Michael, MD  
Krishnamurthy, Satish, MD  
Lavine, Sean, MD  
Levy, Michael, MD  
Liebman, Kenneth, MD

Markert, James, MD  
McCutcheon, Ian, MD  
McKhann, Guy, MD  
Michael, Madison, MD  
Morcos, Jacques, MD  
Notarianni, Christina, MD  
Ogden, Alfred, MD  
Ogilvy, Christopher, MD  
Prabhu, Sujit, MD  
Preul, Mark, MD  
Rabb, Craig, MD  
Sames, Martin, MD  
Shah, Mitesh, MD  
Sheth, Sameer, MD  
Sin, Anthony, MD  
Sisti, Michael, MD  
Solomon, Robert, MD  
Sorenson, Jeffrey, MD

Tjoumakaris, Stavropoula, MD  
Tronnier, Volker, MD  
Veznedaroglu, Erol, MD  
Vyas, Nilesh, MD  
Wang, Michael, MD  
Yoshor, Daniel, MD  
Zager, Eric, MD

## Members' Guests

**Belzberg, Allan, MD**  
(Zager, Eric, MD)

**Bergsneider, Marvin, MD**  
**Liau, Linda, MD**  
(McCutcheon, Ian, MD)

**Choutka, Ondrej, MD**  
**Blazek, Filip, MD**  
**Netuka, David, MD**  
(Sames, Martin, MD)

**Fanous, Andrew, MD**  
**Yoon, Jang, MD**  
(Wang, Michael, MD)

**Golfinos, John, MD**  
(Anderson, Richard, MD)

**Jean, Walter, MD**  
(Marcos, Jacques, MD)

**Kahle, Kristopher, MD**  
(Levy, Michael, MD)

**Sakar, Atom, MD**  
(Veznedaroglu, Erol, MD)

**Schwalb, Jason, MD**  
(Boulis, Nicholas, MD)

**Sisti, Jonathan, MD**  
(Lavine, Sean, MD)

**Smrčka, Martin, MD**  
(Ogilvy, Chris, MD)

**Guthikonda, Bharat, MD**  
(Sin, Anthony, MD)

# Distinguished Service Award



## Neil Kitchen

**N**eil Kitchen has been a long-standing active member of the Society of University Neurosurgeons, hosting a memorable annual meeting in London and becoming President of the Society in 2013. Neil is Senior Consultant Neurosurgeon at the National Hospital for Neurology and Neurosurgery, Queen Square, London, England where he has been Attending Neurosurgeon for the past 27 years. He has served as President of the Society of British Neurological Surgeons as well as the UK Neurosurgical Examination Board Chairman. He remains fully clinically active specializing in neuro-oncology and skull base neurosurgery and is Clinical Director of the Queen Square Radiosurgical Unit. Neil is passionate about international learning and helping neurosurgeons achieve their training goals in order that they can improve neurosurgical provision in their countries of origin. He believes that the SUN exemplifies what can be achieved through dialogue amongst neurosurgical friends from across the globe. He is honored to be a SUN member and humbled to receive this year's Distinguished Service Award.

## Special Speakers



## Michael Zantovsky

**M**ichael Zantovsky is a Czech psychologist, author, diplomat and politician, former Czech Ambassador to the United States, Israel and the United Kingdom, and a former senator of the Czech Parliament and chairman of its Committee on Foreign Affairs, Defense and Security. He currently serves as the Executive Director of the Václav Havel Library, the primary caretaker of the legacy of the late Czech President. In November 1989 he was a founding member of the Civic Forum, an umbrella organization that coordinated the overthrow of the Communist regime in Czechoslovakia. He subsequently served as a spokesman, press secretary and political director to President Václav Havel. He has been a prolific author, translator, journalist, and educator, having translated more than 60 volumes of prose, poetry, drama and non-fiction into Czech. His 2014 biography of his longtime friend Havel: A Life was published in English, Czech and more than a dozen other languages. He has been awarded the 2016 Czech and Slovak Trans-Atlantic Award and the 2017 Foreign Minister's Medal for Meritorious Service to Diplomacy. He has taught American studies and Euro-American relations at Charles University, the New York University in Prague and the CEVRO and CERGE institutes. He was President of Aspen Institute Prague and is currently the Honorary President of Aspen Institute Central Europe. He is a member of the Global Commission for Post-Pandemic Policy. Mr Zantovsky studied psychology at Charles University, Prague and McGill University, Montreal and holds a Masters degree summa cum laude. He worked as a research psychologist in the fields of evolutionary foundations of behavior and theory of motivation at the Psychiatric Research Institute, Prague.



## Liudmyla Verbova, MD, PhD

**L**iudmyla Verbova, MD, PhD is head of the Pediatric Department of the Romodanov Neurosurgery Institute, Kyiv, Ukraine. Professor Verbova also serves as the President of the Ukrainian Association of Pediatric Neurosurgeons.



SUN MEETING

NEW YORK

2023





# SUN 2023

## New York, NY

### Welcome to the BIG APPLE!

We couldn't be more thrilled to host the 61st Annual Meeting of the Society of University Neurosurgeons on the island of Manhattan in New York City and the Hamptons from Sunday July 9th to Friday July 14th, 2023. Although the smallest of the 5 boroughs, Manhattan, aka *The City*, is the urban center of the New York Metropolitan area. By some, Manhattan is considered the cultural, financial, and entertainment capital of the world. From the top of One World Trade Center to the bright lights on Broadway, there are an endless variety of experiences to explore during a visit to Manhattan. In a "New York Minute" you can immerse yourself in one of more than 500 museums and art galleries, splurge on some lavish couture along 5th Avenue, or catch one of the over 200 Broadway and Off-Broadway performances that bring people from around the world to NYC every day. Every culinary pleasure imaginable is available in Manhattan, from enjoying a slice of pizza at the "Famous Original Ray's Pizza" to fine dining at over 60 Michelin star restaurants. Want to take a break from the fast pace of New York City? Try enjoying a leisurely stroll through central park, watch the model sailboats race across the reservoir, or just sit and relax on a park bench while taking in the unique energy of the city. Whatever your fancy, Manhattan will provide an unparalleled opportunity.

SUN members, guests, and families will be staying at the Beekman Hotel in the heart of downtown Manhattan. Rated among the top hotels in Manhattan, the Beekman is a restored historic landmark and one of the first skyscrapers of the New York City skyline. A treasure of lower Manhattan, you will be captivated by the Beekman's Victorian décor and timeless charm, particularly as you enjoy a cocktail in the lounge as the fading sunlight from the atrium skylight above Temple Court fills the room.

Our first two scientific sessions will take place at New York University Langone Medical Center, overlooking the East River of Manhattan. With over twenty physicians at the forefront of basic science, translational, and clinical research, the Department of Neurosurgery at NYU Langone is rated among the nation's premier neurosurgical programs.

From Manhattan, the SUN will travel to Southampton, New York for our satellite scientific session, the gala dinner, and a complete change of pace. Southampton is the oldest and largest community in the "summer colony" of New York, known as the Hamptons, and is a nationally renowned beach resort. We will be staying at the Southampton Inn, where the SUN has booked all of the rooms and will have the entire run of the hotel. With a shuttle to the beach every 10-15 minutes, members and guests will be able to relax on the beach, take a stroll through town, or satisfy their sweet tooth's at the original Tate's Bake Shop.

Plan to attend the 2023 SUN meeting and don't miss the opportunity to visit New York City! Perhaps Ayn Rand captured it best. . . "I would give the greatest sunset in the world for one sight of New York's skyline."

John Golfinos

Richard Anderson

Mike Kaiser

# Meeting Schedule

## Wednesday, June 29, 2022

6:00-10:00 pm: Welcome/ Opening Reception

Grand Mark Prague Hotel

## Thursday, June 30, 2022

6:30-9:30 am: Breakfast

(At your hotel)

### 8:00 am-12:10 pm: General sessions lectures (Hilton)

**Dvorak 1**

8:00-8:10 am: Welcome address

Martin Sames, MD  
Felipe Albuquerque, MD  
Martin Smrcka, MD

### 8:00 am-12:10 pm: Moderator

**Martin Sames**

8:10-8:25 am: History of Neurosurgery in the Czech Republic

M. Sames, MD

8:25-8:40 am: Results of microsurgical management of ACOM aneurysms

A. Hejcl, MD

8:40-8:55 am: Extradural clinoidectomy in proximal ICA aneurysms

J. Klener, MD

8:55-9:10 am: EMIAS Trial - Emergent Microsurgical Intervention in Acute Stroke. Prospective bi-center case-control study

J. Fiedler, MD

9:10-9:25 am: Properties of pituitary adenomas, impact of iMRI and complex tissue investigations

D. Netuka, MD

9:25-9:40 am: Optical coherence tomography and visual evoked potentials in evaluation of optic chiasm decompression

P. Poczos, MD

**9:40-10:10 am: Break with exhibitors**

**Vendor Greeting Session**

10:10-10:25 am: Surgical treatment of thalamic gliomas

M. Smrcka, MD

10:25-10:40 am: Endoscopic management of craniopharyngioma

R. Lipina, MD

10:40-10:55 am: 30 years of gamma knife radiosurgery in Czech Republic

R. Liščák, MD

10:55-11:10 am: CT guided rhizotomy: indications, technique and results

V. Priban, MD

11:10-11:25 am: Our experience with anterior and lateral disc surgery of lumbosacral spine

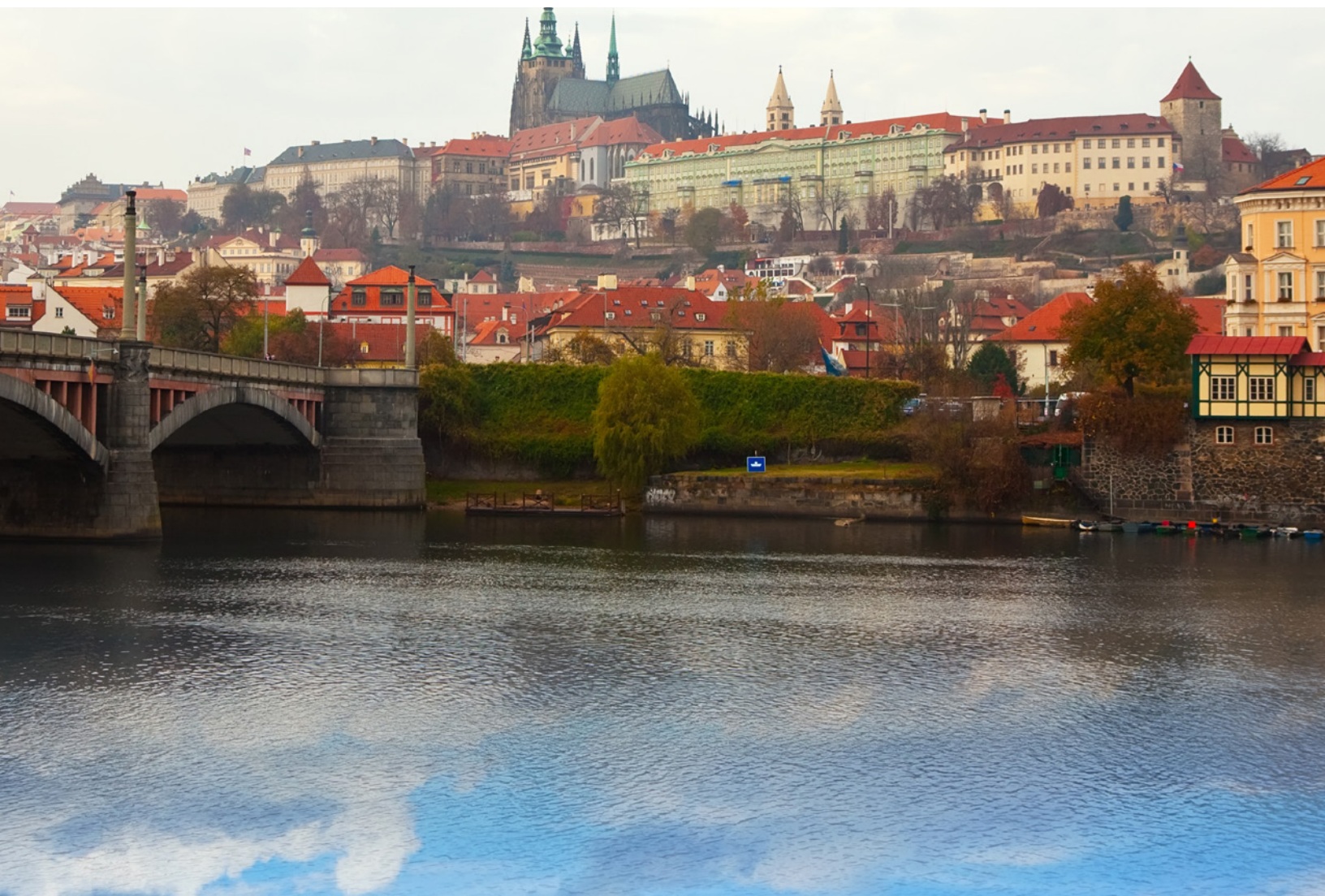
L. Hrabalek, MD



- 11:25-11:40 am: Our treatment strategy evolution of upper cervical spine trauma P. Vachata, MD
- 11:40-12:10 pm: Guest Lecture M. Žantovský The Brain and The Heart of Václav Havel
- 12:30-1:30 pm: Lunch SUNS Delegates Dvorak hall foyer  
(Hilton Old Town Hotel Restaurant)

## Activities:

- 12:30-1:30 pm: Lunch Families - Zinc Restaurant Zinc Restaurant  
(Hilton Old Town Hotel Restaurant)
- 2:00-6:00 pm: Guided Walking Tours (Dress code = casual)  
Grand Prague Tour (Municipal house, Powder Tower, Old town, Charles Bridge, Beer Tasting)
- 7:00-11:00 pm: Municipal house of Prague (Dress = smart casual 3 min. walk)



## Friday, July 1, 2022

|                          |   |  |
|--------------------------|---|--|
| 6:30-9:30 am:            | Breakfast   | (At your hotel)  |
| 7:00-8:00 am:            | <b>Executive committee meeting (Executive only)</b>   | <b>Dvorak 2</b>  |
| <b>8:00 am-12:30 pm:</b> | <b>General sessions lectures (Hilton)</b>   | <b>Dvorak 1</b>  |
|                          | <b>Moderators:</b>  | <b>Michael Kaiser, MD<br/>Christina Notarianni, MD</b> |
| 8:00-8:05 am:            | Introduction of SUN president   | Sean Lavine, MD  |
| 8:05-8:30 am:            | Presidential Address  | Felipe Albuquerque, MD                                 |
| 8:30-8:42 am:            | Improved Patient Outcomes In A Specialized Neurological Emergency Department  | Kenneth Liebman, MD                                    |
| 8:42-8:54 am:            | Cost-effectiveness of screening female smokers for unruptured (IAs) as well as optimal age ranges and interval for screening.                         | Christopher Ogilvy, MD                                 |
| 8:54-9:06 am:            | The Missing Piece of the Puzzle: Sacroiliac Joint Dysfunction as Source of Low Back Pain  | Andrew A. Fanous, MD                                   |
| <b>9:06-9:11 am:</b>     | <b>Discussion</b>   |  |
| 9:11-9:23 am:            | Autologous tumors lysate-loaded dendritic cell vaccination in patients with newly diagnosed glioblastoma: Survival results from a phase 3 trial       | Linda Liao, MD   |
| 9:23-9:35 am:            | Confocal Laser Endomicroscopy for Neurosurgery: Clinical Results of the First FDA-Cleared System with Impact for Neurosurgical-Pathology Telemedicine | Mark Preul, MD   |
| 9:35-9:47 am:            | Immune Response to Oncolytic Herpes Simplex Virus in the Treatment of Glioma  | James Markert, MD                                      |
| 9:47-9:59 am:            | Ventriculoperitoneal shunting using occludable valves in patients with hydrocephalus and leptomeningeal carcinomatosis.                               | Ian McCutcheon, MD                                     |
| <b>9:59-10:04 am:</b>    | <b>Discussion</b>   |  |
| <b>10:04-10:30 am:</b>   | <b>Break with exhibitors</b>  | <b>Vendor Greeting Session</b>                         |
| 10:30-10:42 am:          | Pediatric Auditory Brainstem Implantation (ABI) Experience and Audiometric Outcomes   | John Golfinos, MD                                      |



|                        |  |  |
|------------------------|--|--|
| 10:42-10:54 am:        | Systems-level elucidation of the pathogenesis of human cerebral arachnoid cyst                                 | Kristopher Kahle, MD   |
| 10:54-11:06 am:        | Syndromic craniosynostosis and Hypophosphatasia: What is the role of Tissue Non-specific Alkaline Phosphatase? | Ruth Bristol, MD   |
| <b>11:06-11:11 am:</b> | <b>Discussion</b>  |  |
| 11:11-11:23 am:        | The Michigan Spine Surgery Improvement Collaborative: A Model for a Neurosurgical Quality Improvement          | Jason Schwalb, MD  |
| 11:23 -11:35 am:       | Comparison study reviewing early experience on spine robotics technology using closed vs. open platforms.      | Anthony Sin, MD  |
| 11:35-11:47 am:        | Nerve Transfers for C5-6 Palsies after Cervical Spine Surgery: Need for Earlier Referral?                      | Eric Zager, MD   |
| <b>11:47-11:50 am:</b> | <b>Discussion</b>  |  |
| 11:50-12:20 pm:        | Invited Lecture: Impact of Russian invasion on providing care for pediatric patients in Ukraine.               | Professor<br>Liudmyla Verbova, MD, PhD                         |
| 12:20-12:30 pm:        | Introduction of Distinguished Member Award - Neil Kitchen  | Sander Connolly, MD  |
| <b>12:30-1:30 pm:</b>  | <b>Lunch SUNS Delegates - Dvorak hall foyer</b>  | <b>Dvorak hall foyer</b><br>(Hilton Old Town Hotel Restaurant) |

## Activities:

|                       |   |  |
|-----------------------|---|--|
| <b>12:40-1:30 pm:</b> | <b>Lunch Families - Zinc Restaurant</b>   | <b>Zinc Restaurant</b><br>(Hilton Old Town Hotel Restaurant) |
| <b>2:00-5:00 pm:</b>  | <b>Guided Walking Tours</b> (Dress code = casual)<br>Prague Jewish Quarter  |  |
| <b>7:00-11:00 pm:</b> | <b>Gala Dinner</b> (Dress = Black Tie Optional)<br><b>(Transfer by bus to Castle area, short walk to Palace)</b><br><b>*MEET AT HILTON OLD TOWN LOBBY FOR BUS</b> | Lobkowicz Palace   |

## Saturday, July 2, 2022

|                          |  |  |
|--------------------------|--|--|
| 6:30-9:30 am:            | Breakfast  | (At your hotel)                                |
| 7:00-8:00 am:            | <b>SUN Business Meeting – all members</b>  | <b>Dvorak 1</b>                                |
| <b>8:00 am-12:30 pm:</b> | <b>General sessions lectures (Hilton)</b>  | <b>Dvorak 1</b>                                |
|                          | <b>Moderators:</b>   | <b>Hamad Farhat, MD<br/>Ian McCutcheon, MD</b> |
| 8:00-8:12 am:            | Novel pharmacological targets for the treatment of hydrocephalus   | Satish Krishnamurthy, MD                       |
| 8:12-8:24 am:            | A Novel Web-based Platform and Mobile Phone Application to Evaluate Surgical Competence in Graduate Medical Education.   | Jeffrey Sorenson, MD                           |
| 8:24-8:36 am:            | New insights into the Oscillatory Neural Dynamics in Sensorimotor Cortex Related to Different Tactile Stimulations   | Sujit Prabhu, MD                               |
| 8:36-8:48 am:            | Lesion evolution on MRI following MR-Guided Focused Ultrasound Thalamotomy   | Craig Rabb, MD                                 |
| <b>8:48-9:00 am:</b>     | <b>Discussion</b>  |  |
| 9:00-9:12 am:            | Surgical Revascularization for Vertebrobasilar Disease: Indications and Techniques   | Fady Charbel, MD                               |
| 9:12-9:24 am:            | Treatment of Symptomatic Cerebrovascular Atherosclerosis   | Stavropoula Tjoumakaris, MD                    |
| 9:24-9:36 am             | Paracavernous transtentorial resection of pontine cavernous malformation.  | Aclan Dogan, MD                                |
| 9:36-9:48 am             | Maximal Safe Resection in Thalamic Gliomas improves survival: Single-Center Experience   | Mustafa Baskaya, MD                            |
| <b>9:48-10:00 am:</b>    | <b>Discussion</b>  |  |
| <b>10:00-10:30 am:</b>   | <b>Break with exhibitors</b>   | <b>Vendor Greeting Session</b>                 |
| 10:30-10:42 am:          | Cutaneous malignant melanoma mimicking Malignant Peripheral Nerve Sheath Tumor (MPNST) within Meckel's cave: Utility of Next-Generation DNA Sequencing for Diagnosis | Nilesh Vyas, MD                                |



|                        |  |  |
|------------------------|--|--|
| 10:42-10:54 am:        | Developing a Prediction Model for Identification of Distinct Perioperative Clinical Stages in Spine Surgery With Smartphone-Based Mobility Data.                                       | Jang Yoon, MD  |
| 10:54-11:06 am:        | Surgical Management of Vestibular Schwannoma (Acoustic Neuroma): Facial Nerve Outcomes, Radiographic Analysis, Complications, and Long Term Follow up in a Series of 420 surgeries.    | Jacques Morcos, MD   |
| 11:06-11:18 am:        | Management of 1000 vestibular schwannomas (acoustic neuromas): surgical and Gamma Knife radiosurgery results with an emphasis on facial nerve preservation and complication avoidance. | Michael Sisti, MD  |
| 11:18-11:30 am:        | Advantages and Disadvantages of Hybrid Operating Rooms in Neurosurgery   | Volker Tronnier, MD  |
| <b>11:30-11:42 am:</b> | <b>Discussion</b>  |  |
| 11:42-11:54 am:        | Human Brain Tumors - Molecules and Models  | Atom Sarkar, MD  |
| 11:54 -12:06 pm:       | Acute Flaccid Myelitis   | Allan Belzberg, MD   |
| 12:06-12:18 pm:        | Virtual Reality Exposure Therapy For Neurosurgery  | Jonathan Sisti, MD   |
| <b>12:18-12:30 pm:</b> | <b>Discussion</b>  |  |
| <b>12:30-1:30 pm:</b>  | <b>Lunch SUNS Delegates</b>  | <b>Dvorak hall foyer</b><br>(Hilton Old Town Hotel Restaurant) |

## Activities:

|                       |  |  |
|-----------------------|--|--|
| <b>12:30-1:30 pm:</b> | <b>Lunch Families - Zinc Restaurant</b>                      | <b>Zinc Restaurant</b><br>(Hilton Old Town Hotel Restaurant) |
| <b>2:00-5:00 pm:</b>  | <b>Walking Tours/Historic Trams</b> (Dress code = casual)    |  |
| <b>7:00-11:00 pm:</b> | <b>Dinner</b> (Dress = Casual/Comfortable shoes)             | Vltava River   |
|                       | <b>*WALKING TOUR ENDS NEXT TO SHIP AT DINNER CRUISE DOCK</b> |  |

## 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 11.75 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

The AANS and Society of University Neurosurgeons control the content and production of this CME activity and attempt to ensure the presentation of balanced, objective information. In accordance with the Standards for Integrity and Independence in Accredited Continuing Education established by the Accreditation Council for Continuing Medical Education (ACCME), faculty, abstract reviews, paper presenters/authors, planning committee members, staff and others involved in the planning of the educational content must disclose all financial relationship they or their co-authors have with commercial interests in the past 24 months.

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

| <b>Name</b>            | <b>Disclosure</b>  | <b>Type of Relationship*</b>   |
|------------------------|--|--|
| Christopher Ogilvy, MD | Cerevasc<br>Medtronic  | Consultant<br>DSMB   |
| Fady Charbel, MD       | Transonic, Inc   | Consultant Fee   |
| Gavin Britz, MD        | Department of Defense<br>NIH   |  |
| John Golfinos, MD      | Surgical Theater<br>MLBPA<br>Viewray   | Ownership interest<br>Consultant<br>Stocks or Shareholder  |
| Linda Liau, MD         | ClearPoint Neuro, Inc.<br>Northwest Biotherapeutics, Inc.                      | Board of Directors member<br>PI of clinical trial  |
| James Markert, MD      | Aettis, Inc.<br>Mustang Bio<br><br>Treovir, Inc.<br>Amgen, Inc.<br>Merck, Inc. | Royalties<br>Licensing the IP of C134<br>oncolytic viral therapy. Markert<br>is blinded to conditions<br>for C134 clinical trials<br>Stocks or Shareholder<br>Stocks or Shareholder<br>Grants/Research Support |
| Ian McCutcheon, MD     | Merck, Inc.<br>Vascular Technology   | Speaker<br>Consultant  |
| Jacques Morcos, MD     | Stryker<br>Leica<br>Kogent   | Consultant<br>Consultant<br>Stocks or Shareholder  |



|                             |  |  |
|-----------------------------|--|--|
| Jason Schwalb, MD           | Medtronic<br>Neuros<br>SetPoint<br>Blue Cross Blue Shield of Michigan              | Research funding, paid directly to my employer<br>Research funding, paid directly to my employer<br>Research funding, paid directly to my employer<br>Salary support for my role as co-Director of MSSIC; paid directly to my employer |
| Stavropoula Tjoumakaris, MD | Medtronic<br>MicroVention  | Consultant<br>Consultant   |
| Jang Yoon, MD               | Johnson and Johnson<br>Biedermann Motech<br>Pacira<br>Kinesiometrics<br>MedCyclops | Consultant, Research Support<br>Consultant<br>Consultant<br>Co-Founder, Patent holder<br>Co-Founder  |

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

|                          |                                      |
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| Mustafa Baskaya, MD      | P. Priban, MD                        |
| Allan Belzberg, MD       | Craig Rabb, MD                       |
| Mandy Binning, MD        | Atom Sarkar, MD                      |
| Ruth Bristol, MD         | Anthony Sin, MD                      |
| Sander Connolly, MD      | Jonathan Sisti, MD                   |
| Aclan Dogan, MD          | Michael Sisti, MD                    |
| Hamad Farhat, MD         | Martin Smrcka, MD                    |
| Jiri Fiedler, MD         | Volker Tronnier, MD                  |
| Ales. Hejcl, MD          | Siri Tummalai, MD                    |
| Lumír Hrabálek, MD       | Petr Vachatai, MD                    |
| Kristopher Kahle, MD     | Nilesh Vyas, MD                      |
| Neil Kitchen, MD         | Gelareh Zadeh, MD                    |
| Jan Klener, MD           | Eric Zager, MD                       |
| Satish Krishnamurthy, MD | *Felipe Albuquerque, MD              |
| Michael Levy, MD         | *Ian McCutcheon, MD                  |
| Kenneth Liebman, MD      | *Martin Sames, MD (Host)             |
| Radim Lipina, MD         | *Michael Kaiser, MD                  |
| Roman Liscak, MD         | *Richard Anderson, MD                |
| David Netuka, MD         | *Roberto Suazo                       |
| Christina Notarianni, MD | *Sameer Sheth, MD                    |
| Martin Sames, MD         | *Sean Lavine, MD                     |
| Jeffrey Sorenson, MD     | *Stacie Clark                        |
| Pavel Poczós, MD         | *Stavropoula Tjoumakaris, MD         |
| Sujit Prabhu, MD         | <b>*educational content planners</b> |
| Mark Preul, MD           |                                      |

# Abstracts

## History of Neurosurgery in the Czech Republic

Sames M., Bartos R., Vachata P., Hejcl, Humhej I., Radovnický T., Bolcha M., Malucelli A.

### *Martin Sames, MD*

The first specialized neurosurgical workplaces were established in the Czech Republic at the end of the 1940s and in the 1950s. The founders of the field were Professor Zdenek Kunc from Prague and Professor Rudolf Petr from Hradec Kralove. He went on an internship in America in 1947. He studied there at the clinic of prof. Sachs in St. Louis, and in Chicago with prof. Bailey. He stayed there for about a year and a half, and returned in 1948 to start building modern neurosurgery here on a very rough basis.

The basic steps for the establishment of the Czech Neurosurgical Society were taken in 1955 and since 1963 the CNS has become a member of the WFNS. In 1971, European Association of Neurosurgical Societies (EANS) was founded in Prague during the European Congress, thanks to the world-renowned neurosurgeon academician Z. Kunc.

CNS regularly organizes a national congress with foreign invited speakers every year, on a rotating basis across all university departments. The CNS is very active in the international field. We organized the Eurospine Congress in 2001, EANS Congress in 2014, Cervical Spine Research Society Meeting in 2016 and dozens of WFNS skull bases and neurovascular and neuroendoscopic workshops and courses. We organize Joint Meeting with the Congress of Neurological Surgeons (USA) in Prague in 2012. Czech Neurosurgery and Neurology has its publication forum in the journal The Czech and Slovak Neurology and Neurosurgery (Cesk Slov Neurol N), which was founded even in 1904. It is one of the medical journals with the longest tradition, which is exceptional even in the European perspective.

There are 14 large university workplaces in the population of 10 million in the Czech Republic, which perform 30,000 surgeries per year. The president of the CNS is M. Smrcka, vice-president is M.Sames, executive committee has 11 members T.Cesak, J.Fiedler, R.Jancalek, J.Klener, R.Lipina, D.Netuka, V.Priban, P.Suchomel, M.Vaverka.

---

## Results of microsurgical management of anterior communicating artery aneurysms

Hejčl A.1, Lodin J. 1, Bartoš R. 1, Vachata P.1, Radovnický T. 1, Smolka V. 2, Cihlář F. 2, Sameš M. 1

1Department of Neurosurgery, Masaryk Hospital, J.E.Purkyne University, Ústí nad Labem, Czech Republic  
2Department of Radiology, Masaryk Hospital, J.E.Purkyne University, Ústí nad Labem, Czech Republic

### *Aleš Hejčl, MD*

The aim of the study is to analyze results of microsurgical management of ACom aneurysms treated at our department. We performed a retrospective analysis of patients with ACom aneurysms surgically treated between the years 2006-2016 using our database with prospectively collected data established in 2003. During this time period we operated 132 patients with ACom aneurysms; 39 patients with unruptured aneurysms and 93 patients with ruptured ones. All the patients with unruptured aneurysms underwent surgery resulting in complete aneurysm occlusion except for 1, the residuum of which was later treated with stent-assisted coiling. Three patients experienced epileptic seizures in the postoperative period, 5 patients had temporary CSF leak, 3 patients suffered a slight temporary neurological deficit and 2 patients experienced infectious complications. Unfortunately, two patients underwent severe ischemic (n = 1) or hemorrhagic (n=1) stroke resulting in death. All the remaining thirty-seven patients (95%) with unruptured ACom aneurysms had very good clinical outcome (mRS 0-2). In 93 patients with ruptured ACom aneurysms, 29 of them were admitted as HH 1, 22 as HH2, 24 as HH 3, 8 as HH 4 and 10 as HH5. In the postoperative period 24 patients were treated for hydrocephalus while 28 patients experienced symptomatic cerebral vasospasm. A good outcome (mRS = 0-2) was achieved in 50 (54%) of the treated patients, moderate disability (RS 3-4) was achieved in 15 patients (16%), while 24 patients (26%) were bedridden or died. Four patients were lost to follow up. Overall, the clinical results are comparable to published data from other series. In this lecture we will present our development in surgical therapy for brain aneurysms as well as the treatment algorithm for cerebral vasospasm.

Supported with a grant from the Czech Ministry of Health NU22-08-00124.

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## Extradural clinoidectomy in proximal ACI aneurysms

*Jan Klener, MD*

### Introduction:

Microsurgical treatment of proximal ACI aneurysms requires in most cases an anterior clinoidectomy to expose the proximal part of the neck by opening the distal dural ring and mobilization of the optic nerve by opening its dural sheath. To minimize the risks associated with the immediate proximity of critical structures, in particular the dome of the aneurysm and the optic nerve, knowledge of anatomy and adequate microsurgical technique are necessary. The authors present the technique and results of the anterior clinoidectomy on their own series.

### File:

In the last 10 years, anterior clinoidectomy for proximal ACI aneurysms has been performed in 49 cases (43 women, 6 men, avg. age 51 years). 34 aneurysms were true opthalmic, 10 were other paraclinoid, 4 blister ACI aneurysms and 1 PCom. 9 aneurysms presented by rupture and subarachnoid hemorrhage, other by cephalgia, visual disturbances or were found in coincidence with other lesions. The technique of clinoidectomy was purely extradural in 44 patients, extra-intradural in 4 and only intradural in one patient; in 21 patients, ACC was exposed at the neck at the beginning of the procedure for proximal control, in 2 bypass surgery was used, in 3 adenosine was applied, in 3 a modified Dallas procedure was used and in one the rapid ventricular pacing was done.

### Results:

Anterior clinoidectomy was technically successful in all patients, we did not notice intraoperative rupture during drilling, obvious damage to the optic nerve or other structures. Mortality was 4% (2 pts. after severe SAH), permanent morbidity 8% (1 ischemia in uncertain connection with surgery, one patient with glaucoma experienced permanent visual impairment, two had slight persistent diplopia). Follow up DSA and CTA were performed in 45 patients, in 44 with satisfactory findings, in 1 patient with asymptomatic stenosis of the ACI.

### Discussion:

For anterior clinoidectomy a modified extradural technique according to Dolenc was used in most cases. The key points for the prevention of complications are considered to be the proximal control of ACC on the neck in more complex cases, ample irrigation during

the drilling, early mobilization of the optic nerve and sealing of the clinoidectomy with a fat graft and tissue glue for the prevention of CSF leak.

### Conclusion:

An anterior clinoidectomy is the key step for the microsurgical treatment of most proximal ACI aneurysms. With careful microsurgical technique, successful treatment of these aneurysms with acceptable morbidity can be achieved.

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## Emergent Microsurgical Intervention in Acute Stroke patients after mechanical thrombectomy failure (EMIAS study)

*Jiri Fiedler, MD*

ORCID: 0000-0002-2651-3424

- a) Department of Neurosurgery, České Budějovice Hospital, České Budějovice, Czech Republic
- b) Department of Neurosurgery, Faculty of Medicine in Plzeň, Charles University in Prague, Plzeň, Czech Republic
- c) Department of Neurology, University Hospital Ostrava, Ostrava, Czech Republic
- d) Center for Health Research, Faculty of Medicine, University of Ostrava, Ostrava, Czech Republic
- e) Faculty of medical Sciences, Palacky University Olomouc, Olomouc, Czech Republic
- f) Department of Neurology, České Budějovice České Budějovice, Hospital, Czech Republic
- g) Department of Neurosurgery and Neurooncology, First Faculty of Medicine, Charles University in Prague and Military University Hospital Prague, Czech Republic.
- h) Institute of Physiotherapy and Selected Medical Disciplines, Faculty of Health and Social Studies, University of South Bohemia in České Budějovice, České Budějovice, Czech Republic.
- i) Department of Radiology, University Hospital Ostrava, Ostrava, Czech Republic

### Background and Purpose:

With all the gains that have been achieved with endovascular mechanical thrombectomy revascularization and intravenous thrombolysis logistics since 2015, there is still a subgroup of



patients with salvageable brain tissue for whom persistent emergent large vessel occlusion portends a catastrophic outcome. Study aimed to test the safety and efficacy of emergent microsurgical intervention in acute ischemic stroke patients with symptomatic middle cerebral artery occlusion after failure of mechanical thrombectomy.

#### **Methods:**

A prospective bi-center cohort study was conducted. Acute ischemic stroke patients with middle cerebral artery occlusion who failed to reach recanalization at Center 1 were randomly allocated to the microsurgical intervention group (MSIG) or Control group 1 (CG1). All similar patients at Center 2 were included in the Control group 2 (CG2) with no surgical intervention. Microsurgical embolectomy and/or extracranial-intracranial bypass was performed in all MSIG patients at Center 1.

#### **Results:**

A total of 47 patients were enrolled in the study: 22 at Center 1 (12 allocated to the MSIG and 10 to the CG1) and 25 patients at Center 2 (CG2). MSIG group patients showed a better clinical outcome on day 90 after the stroke, where modified Rankin Scale of 0–2 was reached in 58.3% compared with 10.0% of patients in the CG1 and to 12.0% in the CG2.

#### **Conclusion:**

This study demonstrated the potential for existing microsurgical techniques to provide good outcomes in 58% of microsurgically treated patients as a third-tier option.

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### **Properties of pituitary adenomas, impact of iMRI and complex tissue investigations**

*David Netuka, MD*

#### **Background:**

Structure of pituitary adenoma is one of the features which significantly influences the extent of endonasal pituitary adenoma resection. Intraoperative MRI helps to delineate the residual parts of adenomas and increase the extent of resection. Complex histological evaluation is important in respect to prediction residual pituitary adenoma growth pattern. Several strategies have been applied to predict the structure of pituitary adenoma. It is easy to preoperatively predict the extreme cases, i.e. cystic and heavily calcified tumors. On the other hand, the majority of adenomas lies in a rather gray zone for preoperative prediction of structure and consistency. Radiomic analysis is a rapidly developing field within medical

imaging enabling an objective quantitative extraction of features from imaging data and has been proven to enhance clinical decision making.

#### **Methods:**

Only primary surgeries for histologically confirmed pituitary macroadenomas from a prospectively managed database were included in this study. T2-weighted axial MRIs were acquired and ROIs were placed over the tumor in the slice with the largest tumor area avoiding cystic parts. The ROIs were eroded by 2 pixels to avoid leakage into non-tumor tissue. All voxel intensities were divided by the mean intensity in the second ROI in the cerebral peduncle. Radiomic features were extracted using the pyradiomics module and their ability to identify firm tumors and GTR was evaluated using the independent two-sample t-test. The database of iMRI pituitary adenoma cases was analyzed to evaluate the impact of iMRI on pituitary surgery.

#### **Results:**

For radiomics analysis, 102 patients were included, there were 5 firm tumors and 55 gross totally resected tumors. 55 radiomic features were extracted for each patient. There was no radiomic feature which significantly differed between the groups of soft and firm tumors. The highest t-statistics value was calculated for firstorder\_Skewness ( $t = 1.898$ ,  $p = 0.061$ ). 31 features significantly differed between the groups of gross totally and sub totally resected tumors. The highest t-statistics value was calculated for glrlm\_RunEntropy ( $t = 3.451$ ,  $p = 0.00082$ ). The feature identified as most predictive of GTR was glgm\_LargeDependenceEmphasis (accuracy = 65.7%, AUC = 0.676). iMRI in the whole cohort increased the extent of resection, mostly in giant adenomas and multilobulated and recurrent adenomas.

#### **Conclusion:**

Radiomic analysis of T2-weighted MRIs doesn't allow for reliable preoperative identification of firm tumors. We identified 31 radiomic features that differ significantly in gross totally resected tumors. iMRI improves the extent of pituitary adenoma resection and we recommend to use it as a routine setting.



## Optical coherence tomography and visual evoked potentials in evaluation of optic chiasm decompression

*Pavel Poczos, MD*

### Background:

To explore the benefits of optical coherence tomography (OCT) and visual evoked potentials (VEPs) in optic chiasm (OC) compression.

### Methods:

Prospective study held at University Hospital and Faculty of Medicine in Hradec Králové. 16 patients with OC compression, caused by different sellar pathologies, were included. The main inclusion criterion was the indication for decompressive surgery. Visual acuity (VA), visual field (VF), retinal nerve fibre layer (RNFL) and ganglion cell layer (GCL) thickness, and peak time and amplitude of pattern-reversal (P-VEPs) and motion-onset VEPs (M-VEPs) were measured pre- and postoperatively. The degree of OC compression was determined on preoperative magnetic resonance imaging.

### Results:

There was a continuous postoperative improvement of VA/VF, and thinning of RNFL and GCL ( $p < 0.05$ ). For M-VEPs, there was a significant postoperative shortening of the peak time (N160) and an increase in the amplitude at the second follow-up. P100 peak time and its amplitude did not change significantly.

### Conclusions:

The M-VEPs N160 amplitude showed a close relationship to the VF improvement. However, in VEPs there was a smaller proportion of significant correlations with preoperative or postoperative VF defects compared to the retinal markers. Thinner preoperative RNFL does not present a statistically important limiting factor for better functional outcomes. The morphological status of the sellar region should be taken into consideration when one evaluates the chiasmal syndrome. M-VEPs enable detection of functional changes in the visual pathway better than P-VEPs.

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## Surgical approach for thalamic tumors

*Martin Smrcka, MD*

### Introduction:

Thalamic tumors are relatively rare tumors growing in a highly functional part of brain. They are more frequent in pediatric population. Their surgery is challenging and a high morbidity is possible. Relatively benign nature of many of these tumors means that an attempt for radical resection should frequently be performed. The approach has to be very carefully planned, sometimes with the help of modern diagnostic methods like DTI. The location and projection of the tumor in the thalamus plays an important role in choosing the approach.

### Material:

We have studied a group of 17 patients with thalamic tumors treated from 2005 - 2021. There were 14 males and 3 females, age ranged from 1 - 65 years (mean 17,5 years). Transcortical approach was used 9x, transcallosal 5x, transsylvian 2x and supracerebellar infratentorial 1x. One patient is being observed only.

### Results :

Gross total resection was achieved in 7 cases, subtotal in 5 and partial in 4. There were 8 pilocytic astrocytomas, one subependymal giant cell astrocytoma, 2 diffuse astrocytomas G II and 4 glioblastomas, one metastasis. Three GBM patients have died, others are alive with the mean follow-up 10 years. There were two severe disability patients in the group..

### Conclusion:

Thalamic tumors might be safely radically resected if correct approach is used. The choice of approach is based in the projection of the tumor. Smaller tumors which are not close to the thalamic surface might be followed or biopsied if there is a likelihood of its malignant nature. Oncological treatment should be reserved for malignant tumors.

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## Endoscopic management of craniopharyngioma

*Radim Lipina, MD*

### Authors:

Radim Lipina  
Department of Neurosurgery, University Hospital Ostrava  
Petr Matoušek  
Department of Otorhinolaryngology, University Hospital Ostrava

**Objective:**

Craniopharyngiomas are benign tumors, but sometimes it is challenging to achieve long-term control of these tumors without postoperative morbidity. Endoscopic treatment is an alternative approach for suprasellar and intraventricular localization of craniopharyngiomas.

**Methods:**

From 2010 to March 2020, we performed 29 transnasal or transventricular endoscopic procedures for craniopharyngioma. We evaluated the extent of resection, complication, and postoperative visual and endocrinologic outcomes. We compared these results with the retrospective data of patients treated in our institution between 2002-2020 using the transcranial approach.

**Results:**

We performed transnasal endoscopic resection in 21 patients with intra/suprasellar craniopharyngioma localization. For eight patients with suprasellar/ intraventricular localization, we operated using the transventricular endoscopic approach. The radicality of resection in the transnasal group was 71%, in the endoscopic transventricular group at 0%, and in transcranial operated groups at 44%. The visual improvement was 89% in the transnasal endoscopic group and 100% in the transventricular endoscopic group. Postoperative endocrinological worsening occurred more often in the transcranial group (67% vs. 47% in the transnasal group and 0% in the transventricular group). There was a higher incidence of postoperative CSF leak in the transnasal endoscopic group (33% vs. 11% in the transcranial group and 0% in the transventricular group).

**Conclusion:**

Endoscopic treatment is a method of choice for treating craniopharyngiomas in different localization. In our experience, the transventricular endoscopic approach is safe. It is possible to use it in suprasellar/ intraventricular localization, especially in recurrent cases, but it is impossible to achieve a radical resection. The transnasal endoscopic approach offers the same rate of radicality resection, a higher rate of visual improvement, and a lower postoperative endocrinopathy rate than the transcranial approach. Reducing the incidence of postoperative CSF leak is a challenge for the future.

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**30 years of gamma knife radiosurgery in Czech Republic**

*Roman Liscak, MD*

There are currently around 350 Leksell gamma knives in operation worldwide. Prague's Leksell gamma knife, which bears the serial number 37, was the eighth in Europe and, for a period of more than ten years, was the very first in Eastern Europe. Leksell gamma knife was installed in Prague's Na Homolce Hospital in October 1992. Gamma knife radiosurgery in the Czech Republic could not have reached its current status without the Charter 77 Foundation and the money collections it organized more than 30 years ago. This collection was the first major collection made in the post-revolution Czechoslovakia. The Charter 77 Foundation became the first, and we can say a model foundation, whose activities encouraged an enormous expansion in charitable organisations as well as making a significant contribution to the development of civil society in the new Czechoslovakia. More than 24,000 gamma knife procedures have been performed in our department over 30 years, with more than 1,000 annual treatments in recent years. This makes the gamma knife in Prague one of the busiest instruments of its kind.

---

**CT guided percutaneous glycerol rhizolysis in the treatment of trigeminal neuralgia**

*V.Priban, MD*

Seidl M1, Baxa J2, Priban V1.  
1-Department of Neurosurgery, 2-Department of Radiology, University Hospital Plzeň, Czech Republic.

Trigeminal neuralgia can be primary (neurovascular conflict present in 80%) or secondary (herpes, multiple sclerosis, tumor...) Incidence of neuralgia is 4/100 000. When neurovascular conflict is present, microvascular decompression is method of choice in our institution. In the case that conflict is not present on MRI, patient rejects surgery or operation is contraindicated percutaneous rhizolysis is an option. In our institution glycerol rhizolysis is used for many years. In the past puncture has been performed under fluoroscopy. Since 2019 we perform CT guided glycerol rhizolysis. Procedure is performed under analgesia. Foramen ovale is reached using standard technique (needle G20/22, CSF aspiration, contrast) CT 3D reconstruction is performed as a proof of correct needle position before contrast application. 85% glycerol is then injected into Meckel cave. In last four years 22 glycerol rhizolysis were performed. Complete



relief was recorded in 13 cases, partial effect in 3 cases and failure in 6 cases (with relief in three cases after repeated puncture). Radiation dose was 0.19mSv under CT (0.03mSv under fluoroscopy).

### **Conclusion:**

CT guided percutaneous glycerol rhizolysis is more precise and safer in comparison with fluoroscopy. Higher radiation dose is acceptable in this procedure.

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### **Abstract: Our experience with anterior and lateral disc surgery of lumbosacral spine**

Hrabálek Lumír, Blažek Filip

#### ***Lumír Hrabálek, MD***

Spinal surgery is a major and important part of Neurosurgery for all neurosurgical departments in the Czech Republic (60 % of all surgeries at our department). We perform around 1000 spinal surgeries per year, including lumbosacral interbody fusions. In the past 25 years, we have done ALIF (Anterior Lumbar Interbody Fusion) on 371 patients, OLIF (Oblique Lumbar Interbody Fusion) on 132 patients, and LLIF (Lateral Lumbar Interbody Fusion) on 253 patients. We present our results of these surgeries using PEEK (Poly-Ether-Ether-Keton) and titanium cages, including complications, clinical and radiological outcomes and experiences with intra-operative neuromonitoring. Moreover, we present the development of our new implant for „stand-alone“ LLIF procedure (XLIF Lumir cage) and first results of using it for the past 4 years.

---

### **Our treatment strategy evolution of upper cervical spine trauma**

Vachata Petr, Lodin Jan, Sameš M

#### ***Petr Vachata, MD***

The evolution of cranio-cervical instrumentation systems, intraoperative imaging and intraoperative navigation changed our treatment strategy in the management of upper cervical spine trauma throughout the last two decades. Similarly, to the management of cranio-cervical junction tumors, the current strategy for upper cervical trauma tend to be minimally invasive with limited permanent fusion and maximal preservation of range of movement. Halo traction has been completely excluded from our treatment protocol based on current evidence. We successfully introduced the isolated open reduction and fixation of the atlas and percutaneous fixation of Hangman's fractures. On the other hand, based on our studies concerning bone quality and range

of movement in the C1-C2 segment, we increased the rate of indication of posterior fixation in selected cases with odontoid C2 fractures. The presentation is illustrated by clinical cases.

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### **Improved Patient Outcomes In A Specialized Neurological Emergency Department**

#### ***Kenneth Liebman, MD***

### **Introduction:**

Stroke is now the fifth leading cause of death in the U.S., but remains the leading cause of long term disability. Target: Stroke helps hospitals achieve improved stroke outcomes through reduced door-to-needle times for eligible stroke patients. Phase III of the American Heart Association/American Stroke Association initiative set more aggressive targets for timely treatment with IV alteplase. To achieve rapid treatment times and better patient outcomes, we created a neurologic emergency department (Neuro ED). Neuro ED hours are staffed by emergency physicians with specialized neuroscience training and administer IV alteplase independently.

### **Methods:**

This is a retrospective observational study from 2019-2021 comparing outcomes of acute ischemic stroke patients who received IV alteplase following implementation of the neurologic emergency department compared to a traditional emergency department (TED). The following metrics were calculated for each patient: Door to Needle times (DTN), door to CT times (DTCT), and pre and post National Institute of Health Stroke Scale (NIHSS)

### **Results:**

74 patients were treated in the Neuro ED and 45 patients were treated in the TED. Average DTN times in the Neuro ED were 27 minutes compared to 65 minutes in the TED. Patients treated in the Neuro ED achieved DTN times of 45 min or less 87% of cases, while only 24% of the time in the TED. Patients treated in the Neuro ED achieved DTN times of 30 min or less 65% of cases, with only 4% of cases in the TED. Average DTCT times in the Neuro ED were 8 minutes faster than the TED. No differences in admission NIHSS were found with an average of 8.75, but a significant improvement was found in discharge NIHSS. Average discharge NIHSS was 3.8 for Neuro ED stroke patients compared with 5.6 for TED patients ( $p < 0.001$ ).

### **Conclusion:**

Implementation of a Neuro ED led to swift management and improved symptoms for stroke

patients. A dedicated Neuro ED is highly effective in improving DTN times, DTCT times, and overall stroke outcomes.

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### **Cost-effectiveness of screening female smokers for unruptured (IAs) as well as optimal age ranges and interval for screening.**

*Christopher Ogilvy, MD*

#### **Background and objective:**

The prevalence of intracranial aneurysms (IAs) among female smokers was shown high in studies, yet the cost-effectiveness of them has never been studied. This study aims to explore cost-effectiveness of screening female smokers for unruptured (IAs) as well as optimal age ranges and interval for screening.

#### **Methods:**

A decision analytical study was performed with a Markov model to compare different screening strategies with no screening. Input data for the model was mainly extracted literature. A single screening at different ages, and multiple screening every 15 years, 10 years, 5 years and 2 years were performed for female smokers in different age ranges in a lifetime horizon. Costs, effects and incremental cost-effectiveness ratio were compared with no screening, decreased rupture rates of aneurysm and net health benefits were also calculated for comparison. Deterministic and probabilistic sensitivity analyses were performed to evaluate the robustness of the Model.

#### **Results:**

Costs, effects and ICER, decreased rupture rates of the aneurysm and net health benefits were calculated. Deterministic and probabilistic sensitivity analyses were performed to evaluate the robustness of the Model. Screening female smokers for unruptured intracranial aneurysms is cost-effective. All screening strategies yield extra Quality Adjusted Life Years (QALYs). Frequent screening strategies decrease the rupture rate of aneurysms more. However, a single screening strategy at younger age brings the highest effect and health net benefit with the least cost per QALY. The upper age limit for a single screening is 72. And screening every 2 years after the age of 60 is not optimal.

#### **Conclusions:**

Given the current literature and our model, screening female smokers is cost-effective. A single screening at a younger age is most optimal. However, in practice, the

duration and intensity of exposure to cigarettes should be taken into consideration.

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### **Intraarterial Verapamil for Neuroprotection in Ischemic Stroke**

*Mandy Binning, MD*

#### **Introduction:**

Neuroprotective efforts are paramount when dealing with acute ischemic stroke. Neuroprotective compounds used within 24 hours of stroke onset can help prevent cell damage and improve clinical outcomes. Verapamil is an FDA approved calcium channel blocker that has been administered as treatment of vasospasm. Preclinical studies have shown that verapamil is associated with reducing inflammation and protecting penumbra neurons from further damage and death. We are seeking to investigate the safety and efficacy of verapamil injection via intra-arterial delivery for neuroprotection in a clinical population.

#### **Methods:**

Verapamil study patients are recruited based on inclusion criteria, including have experienced an acute ischemic stroke or computed tomographic scan consistent with acute cerebral ischemia. Investigators administered 10 mg verapamil during thrombectomy procedure and patients were followed up with as standard of care. The National Institutes of Health Stroke Scale was used as a predictor of patient outcome and Modified Rankin Scale was assessed to measure neurologic disability following stroke.

#### **Results:**

The verapamil group included a total of 19 patients ranging in age from 38 to 75 years old with a mean of 60.5 years of age. All 19 patients presented with an MCA occlusion and underwent mechanical thrombectomy for acute ischemic stroke. Within the verapamil study group of seventeen patients, seven (41.2%) received tPA within 4.5 hours of symptom onset. Mean presenting NIHSS among total patients was  $10.2 \pm 5.6$ , and the median was 11. Sixteen of the 17 (94.1%) total patients exhibited complete reperfusion with a score of TIC1 2b/3.

#### **Conclusions:**

Previous preclinical studies have supported the use of verapamil delivered IA for neuroprotection in treatment of vasospasm. This study suggests that verapamil is a safe and effective neuroprotective drug used in clinical populations that have experienced an

ischemic stroke and require mechanical thrombectomy for treatment.

### **Autologous tumors lysate-loaded dendritic cell vaccination in patients with newly diagnosed glioblastoma: Survival results from a phase 3 trial**

*Linda Liaw, MD*

Glioblastoma is the most lethal primary brain cancer. Clinical outcomes for glioblastoma remain poor, and new treatments are needed to improve the prognosis of patients with this devastating disease. The main objective of this study was to investigate whether adding autologous tumor lysate-loaded dendritic cell vaccine (DCVax-L) to standard of care (SOC) extends survival.

An international, multi-center Phase 3 randomized, double-blinded trial with crossover was conducted in 94 sites in 4 countries (November 2007- 2015), with follow-up through October 2020. 331 patients 18 – 70 years of age with unilateral glioblastoma (GBM) whose tumor was resected and had completed concomitant radiochemotherapy (median time from diagnosis to randomization, 3.1 months) were enrolled. Synthetic control arms were comprised of 1,366 newly diagnosed GBM (nGBM) and 640 recurrent GBM (rGBM) external control subjects from contemporaneous randomized controlled trials that were independently identified based on pre-specified criteria.

Patients were randomized 2:1 to DCVax-L plus maintenance temozolomide chemotherapy (n=232) or placebo plus temozolomide (n=99). The majority of placebo patients crossed over to receive DCVax-L at the time of recurrence. 232 received DCVax-L following original diagnosis, and 64 placebo patients received DCVax-L following disease recurrence. At the time of recurrence, patients received SOC physician's choice, lomustine or bevacizumab.

The primary and secondary endpoints compared overall survival (OS) in nGBM and rGBM, respectively, with the external controls. Four sets of analyses were conducted to confirm rigorous matching, reduce/eliminate known and unknown potential biases, and confirm the robustness of survival results. Median OS (mOS) for nGBM patients (n=232) was 19.3 months from randomization (22.4 months from surgery) with DCVax-L vs. 16.5 months from randomization in the external controls (HR=0.80, p=0.002). Survival at 48 months from randomization was 15.7% vs. 9.9%, and at 60 months was 13% vs. <5.7%. For rGBM (n=64), mOS was 13.2 months from relapse vs. 7.8 months in the

controls (HR = 0.58, p<0.001). Survival at 24 months post-recurrence was 20.7% vs. 9.6%, and at 30 months post-recurrence was 11.1% vs 5.1%. In nGBM patients with methylated MGMT (n=90), mOS was 30.2 months from randomization (33 months from surgery) with DCVax-L vs. 21.3 months from randomization in the controls (HR=0.74, p=0.027). The treatment was very well tolerated.

In conclusion, the addition of DCVax-L to SOC resulted in a clinically meaningful and statistically significant extension in overall survival for both nGBM and rGBM

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### **Confocal Laser Endomicroscopy for Neurosurgery: Clinical Results of the First FDA-Cleared System with Impact for Neurosurgical-Pathology Telemedicine**

Irakliy Abramov MD PhD, Yuan Xu MD, Evgenii Belykh MD PhD, Jennifer M. Eschbacher MD, and Mark C. Preul MD\*

*Mark Preul, MD*

#### **Introduction:**

We evaluated the feasibility of the use of the first clinical-grade confocal laser endomicroscopy (CLE) system using fluorescein sodium for intraoperative in vivo imaging of brain tumors in 30 patients. In the last 11 patients we also evaluated an innovative telesurgical pathology software platform (TSP) that was incorporated into the system.

#### **Methods:**

CLE) A CLE system cleared by the US FDA was used in 30 prospectively acquired patients with brain tumors (13 gliomas, 5 meningiomas, 5 other primary tumors, 4 metastases, 4 reactive brain tissue). CLE images were classified by a neuropathologist as interpretable or noninterpretable. Images were compared to corresponding frozen and permanent histology sections, with image correlation to biopsy location using neuronavigation. The specificities and sensitivities of CLE images and frozen sections were calculated using permanent histological sections as the standard for comparison.

TSP) TSP system was used in 11 cases (gliomas 6, other primary 3, metastasis 1, reactive brain tissue 1). Neurosurgeons using CLE generated video-flow images of the operative field displayed on monitors in the operating room. The pathologist simultaneously viewed the CLE video-flow using a digital tablet and



communicated with the surgeon while physically located outside the operating room (another state 1, home 4, elsewhere in the hospital 6). Interpretation of still CLE images and CLE video-flow imaging were compared to corresponding frozen and permanent histology sections to provide real-time intraoperative neuropathologist consultation.

### **Results:**

CLE) 10,713 CLE images from 335 regions of interest were acquired. The mean duration of the use of the CLE system was 8 minutes. Interpretable CLE images were obtained in all cases. The first interpretable image was acquired within a mean of  $6 \pm 10$  images and within  $5 \pm 13$  s; 4,896 images (46%) were interpretable. Interpretable image acquisition was positively correlated with study progression, number of cases by surgeon, cumulative time used, and time used per case ( $p \leq 0.01$ ). The diagnostic accuracy, sensitivity, and specificity of CLE compared to frozen sections were 94%, 94%, 100%, respectively, and the diagnostic accuracy, sensitivity, and specificity of CLE compared to permanent histological sections were 92%, 90%, and 94%, respectively. No difference was observed between different lesion types for the time to first interpretable image ( $p = 0.35$ ). Deeply located lesions were associated with a higher percentage of interpretable images compared to superficial lesions ( $p = 0.02$ ). The study met the primary endpoints, confirming the safety and feasibility and acquisition of noninvasive digital biopsies in all cases. The study met the secondary endpoints for the duration of CLE use necessary to obtain interpretable images. A neuropathologist could interpret the CLE images in 29/30 cases (97%), with the interpretation of CLE images correlating to histopathology in 92% of biopsies.

TSP) 24 optical biopsies were acquired with a mean of  $2 \pm 1$  optical biopsies per case. The mean duration of CLE system use was  $1 \pm 0.3$  minutes/case and  $0.25 \pm 0.23$  seconds/optical biopsy. The first image with identifiable histopathological features was acquired within  $6 \pm 0.1$  seconds. Frozen sections were processed within  $23 \pm 2.8$  minutes, significantly longer than CLE usage ( $p < 0.001$ ). CLE video-flow interpreted tissue histoarchitecture correctly in 96% of optical biopsies, substantially higher than the accuracy of still CLE images (63%) ( $p = 0.005$ ).

### **Conclusions:**

A clinical-grade CLE system allows intraoperative, in vivo, high-resolution cellular visualization of tissue microstructure and identification of lesional tissue

patterns in real-time, without the need for tissue preparation. The CLE system achieved all feasibility study goals. This CLE system is a promising technology that produces an "optical biopsy" for real-time high-resolution visualization of tissue microstructure intraoperatively, allowing identification of lesional tissue. The TSP establishes real-time on-the-fly remote communication between the neurosurgeon using CLE and the pathologist. When employed in tandem with TSP, neurosurgeons and pathologists can view and interpret the CLE images remotely in real time without the need to biopsy tissue. TSP allowed neurosurgeons to receive real-time feedback on optically interrogated tissue microstructure, improving cross-functional communication and intraoperative decision-making, and indicating significant workflow advantages over the frozen section process.

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## **Immune Response to Oncolytic Herpes Simplex Virus in the Treatment of Glioma**

*James Markert, MD*

### **Introduction:**

Malignant glioma remains a daunting challenge for neurosurgeons and neuro-oncologists but in particular for their patients, despite decades of research. These tumors have been largely resistant to the use of immunotherapy, presumably due to a combination of few neoantigens and low numbers of tumor infiltrating lymphocytes, as well as high numbers of tumor associated macrophages that suppress the immune response. We are studying the use of oncolytic herpes simplex virus as a potential mechanism to overcome this immune resistant phenotype.

### **Methods:**

We utilized samples from a previously published study in which tumors had been treated with oncolytic virus and then tumor harvested 2-5 days later with retreatment of the tumor bed. Tumor specimens were analyzed for immune response after the first dose. Additional data from two subsequent phase-1 studies, one utilizing an oncolytic HSV deemed M032 that expresses IL-12 and a second utilizing a chimeric HSV that includes an immuno-stimulatory gene from human cytomegalovirus, were also evaluated. Immune response to these tumors was evaluated when tumors were re-operated after treatment for concerns about progression or pseudo-progression.

### **Results:**

Tumor that had been previously treated with oncolytic virus in both the short term as well as the intermediate to longer term, showed increased numbers of

infiltrating lymphocytes post viral treatment. These lymphocytes were found to exhibit cytotoxic profiles as well as evidence of an exhausted phenotype.

### **Conclusions:**

Treatment with oncolytic herpes simplex virus appears to consistently produce immune infiltration of gliomas post treatment, including a response consistent with cytotoxic CD8 and CD4 cell involvement. The presence of an exhausted phenotype may favor concurrent study of these viruses with associated checkpoint inhibitors. FDA approval for such a study has recently been obtained.

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## **Ventriculoperitoneal shunting using occludable valves in patients with hydrocephalus and leptomeningeal carcinomatosis.**

Ian E. McCutcheon, M.D., Kristin Huntoon, D.O., Ph.D.

### ***Ian McCutcheon, MD***

#### **Introduction:**

Leptomeningeal dissemination of tumor cells (LMD) is a highly morbid complication of cancer. Hydrocephalus causing intracranial hypertension (IC-HTN) are known sequelae of LMD, but ventriculoperitoneal shunt (VPS) placement prevents intrathecal (IT) chemotherapy from gaining effective distribution within the cerebrospinal fluid compartment. While prior studies have demonstrated the palliative effect of VPS placement in the setting of LMD-associated intracranial hypertension, the reported experience with combined VPS/Ommaya systems with incorporated on-off valves (reversible occlusion shunts) has been limited.

#### **Objective:**

We report survival outcomes and safety experience of VPS with an on-off valve and in-line Ommaya reservoir for the treatment of hydrocephalus and intracranial hypertension in the setting of LMD. We aim to clarify the excess morbidity and/or mortality imposed by hydrocephalus when it arises in patients with LMD, and ultimately whether control of ICP elevation combined with IT chemotherapy lengthens their survival.

#### **Methods:**

An IRB-approved review was conducted of all adult patients (n=55) with LMD who received a VPS with on-off valve at our institution between November 1996 and December 2021. The most common tumors were melanoma (n=20) and breast (n=17) carcinoma. Patients were diagnosed by MRI and/or CSF analysis. Differences in survival were assessed using Student's t-test.

### **Results:**

Significantly longer survival occurred in patients with an on/off valve VPS/Ommaya system and who received > 3 IT treatments (n=23; overall survival from implantation  $9.31 \pm 13.81$  months) versus those who received an occludable shunt but no IT treatments (n=25; overall survival from implantation  $2.76 \pm 3.39$  months,  $p < 0.0261$ ). Peritoneal carcinomatosis after shunting was infrequent (2/55; 3.6%).

### **Conclusions:**

This is the largest series of patients with shunts with on/off valve placed to relieve symptoms of intracranial hypertension in patients with LMD. Such shunts improve survival significantly and improve quality of life while allowing meaningful administration of intrathecal chemotherapy and significant prolongation of life.

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## **Pediatric Auditory Brainstem Implantation (ABI) Experience and Audiometric Outcomes**

Yosef Dastagirzada MD1, David Harter MD1, Jeffrey Wisoff MD1, Emily Kay Rivest MD, MSC2, Alexander Eremiev BS1, William Shapiro AuD2, Susan B. Waltzman PhD,2 J Thomas Roland MD2, John G. Golfinos MD1  
1 Department of Neurosurgery, NYU Langone Medical Center, New York, New York;  
2 Department of Otolaryngology, NYU Langone Medical Center, New York, New York;

### ***John Golfinos, MD***

#### **Introduction:**

Auditory brainstem implantation (ABI) in the pediatric population was trialed 17 years after its creation in 1984 by Dr. House.<sup>1,2</sup> Since that seminal paper, majority of surgical complication and outcome data has pertained to adult patients with neurofibromatosis and the pediatric data remains sparse.<sup>3-5</sup> We aimed to describe our experience and delineate demographic data, audiometric outcomes, and surgical parameters.

#### **Methods:**

An IRB approved, retrospective chart review was conducted amongst our pediatric patients who had undergone auditory brainstem implantation from 2012-2021. Demographic information included gender, age, race, coexisting syndrome(s), history of cochlear implant placement, average length of implant use, and follow-up. Surgical parameters collected included approach, intraoperative findings, number of electrodes activated, and complications.

## Results:

A total of 19 pediatric patients had an auditory brainstem implant placed at our institution, 10 male (52.6%) and 9 female (47.4%) with a mean age at surgery of 4.7 years [1.5-17.8]. Majority of children were white (57.9%) and Asian (26.3%). Four patients (21%) had a coexisting syndrome and 11 patients (57.9%) had a history of a cochlear implantation which were ineffective in majority of cases and required removal. The mean length of implant use was 5.31 years [0.25-10] and our average follow-up was 47.85 months. All 19 cases were performed through a retrosigmoid corridor and the most common intraoperative finding was an absent/atretic vestibulocochlear nerve (73.7%). 6 patients (31.6%) experienced CSF related complications postoperatively (5 CSF leaks, 1 hydrocephalus requiring CSF diversion). Most recent audiometric outcomes demonstrated that 15 patients (78.9%) showed improvement in their hearing ability: 5 with sound/speech awareness, 5 able to discriminate amongst speech and environmental sounds, and 5 able to understand common phrases/conversation without lip reading. 9 patients (47.4%) are in school for the deaf and 7 (84.2%) are in mainstream school with support.

## Conclusion:

Our surgical experience with a multidisciplinary team demonstrates that the retrosigmoid approach for ABI placement in children with inner ear pathologies and severe sensorineural hearing loss is a safe and effective treatment modality. Audiometric outcome data showed that nearly 79% of our patients had an improvement in their environmental and speech awareness. The most common complication noted was CSF leak, 3 patients responded well to conservative treatment with lumbar drain placement and 2 patients required exploration for repair. Further multicenter collaborations are necessary to improve these outcomes and potentially standardize/enhance electrode placement.

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## Systems-level elucidation of the pathogenesis of human cerebral arachnoid cyst

Adam J. Kundishora<sup>1,†</sup>, Garrett Allington<sup>2,3,†</sup>, Stephen McGee<sup>4, †</sup>, Kedous Mekbib<sup>1,3,†</sup>, Vlad Gainullin<sup>4, †</sup>, Emre Kiziltug<sup>1</sup>, Carol Nelson-Williams<sup>1</sup>, Andres Moreno-De Luca<sup>5</sup>, Hannah Smith<sup>1,3</sup>, Jack Ocken<sup>1</sup>, John Shohfi<sup>1</sup>, Phan Q. Duy<sup>1</sup>, August Allocco<sup>1</sup>, Shujuan Zhao<sup>6</sup>, Yung-Chun Wang<sup>6</sup>, Andrew Timberlake<sup>1</sup>, Shrikant Mane<sup>7</sup>, Christopher Castaldi<sup>7</sup>, Francesc López-Giráldez<sup>7</sup>, James R. Knight<sup>7</sup>, Charuta Furey<sup>1</sup>, Po-Ying Fu<sup>6</sup>, Hanya Qureshi<sup>1</sup>, Aladine Elsamadicy<sup>1</sup>, Pasko Rakic<sup>8</sup>, Shozeb Haider<sup>7</sup>, Seth T. Alper, Francisca M. Zamora<sup>4</sup>, Richard P. Lifton, Kyle Retterer<sup>4</sup>, Rebecca Torrene<sup>4†</sup>, Sheng Chih Jin<sup>6,10†</sup>, and Kristopher T. Kahle<sup>1,3,11,12,13,14,15†</sup>

### *Kristopher Kahle, MD*

Arachnoid cysts (ACs), the most common space-occupying lesion in humans, are leptomenigeal-lined, cerebrospinal fluid-filled sacs that interdigitate between the major developmental folds of the cortex. To elucidate AC pathogenesis, we performed an integrative systems-level analysis of exome sequencing data from a 617 proband-parent trio pediatric AC cohort (1,851 total individuals), single-cell (sc)-RNAseq data of the developing brain and meninges, and phenomic data from artificial intelligence-mined patient medical records. We identified marked enrichment of damaging de novo variants (DNVs) in genes highly intolerant to loss-of-function variation ( $pLI \geq 0.9$ ) ( $P = 1.57 \times 10^{-33}$ ) in AC cases but not controls. 7 genes had a genome-wide significant burden of damaging or protein-altering DNVs. 22 other genes had  $\geq 2$  damaging DNVs. 3 genes had identical DNVs in unrelated probands. Together, damaging DNVs accounted for 23.5% of cases. AC risk genes are highly enriched for chromatin modifiers, including interacting components of the neural-specific ATP-dependent BAF (SWI/SNF) chromatin remodeling complex and multiple enzymes that regulate histone



3 lysine 4 (H3K4) methylation. AC genes converged in co-expression modules in the midgestational cortex previously implicated in autism, and in arachnoid cell module important for cell-cell adhesion. Unsupervised clustering of phenotype data identifies clinical subtypes of AC. These findings implicate epigenomic dysregulation due to de novo mutation in AC pathogenesis and highlight the importance of precise transcriptional control for the coordinated development of the brain and leptomeninges. In the appropriate context, ACs may be considered radiographic harbingers of neurodevelopmental pathology that may warrant genetic follow-up and non-surgical early intervention.

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## **Syndromic craniosynostosis and Hypophosphatasia: What is the role of Tissue Non-specific Alkaline Phosphatase?**

*Ruth Bristol, MD*

### **Introduction:**

Tissue non-specific alkaline phosphatase (TNAP) is an enzyme of skeletal origin that is active during neonatal development. TNAP functions are broad and include tissue mineralization during cranial vault formation. Downregulation of the TNAP gene is linked to the early fusion of cranial sutures in mouse models of craniosynostosis. Here we investigate the relationship between pre-operative serum TNAP levels in patients undergoing surgical repair of various craniosynostoses, in order to assess for any clinical significance. These patients are compared with those suffering from hypophosphatasia, which is the congenital absence of TNAP.

### **Methods:**

We retrospectively evaluated serum TNAP level that were obtained on routine pre-operative labs in this patient cohort. Subgroup analysis was carried out between various groups depending on number of sutures affected and syndromic status. Two patients with hypophosphatasia were evaluated for premature suture closure.

### **Results:**

Serum TNAP levels did not differ significantly between patients with single suture vs. syndromic craniosynostosis. Although the mean TNAP level was slightly higher for the patients undergoing endoscopic repair, this reflected the younger at which the minimally invasive surgery is performed. There was a trend toward lower serum TNAP levels in patients with syndromic vs non-syndromic multi-suture synostosis,

who underwent open surgical repair and cranial vault reconstruction, however this remained in the normal range. Of the two patients with hypophosphatasia, both had significantly low TNAP levels. Neither patient exhibited craniosynostosis in the infant period, but both developed multiple suture closures in early childhood.

### **Conclusions:**

In humans, TNAP expression, whether through skeletal isoenzyme gene downregulation or mutation, may play a role in the premature closure of cranial sutures. However, this process is complex. Although animal models show a decrease in suture closure with asphatase alpha treatment, the opposite appears to be true in humans. Further study may elucidate the specific mechanisms in this process.

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## **The Michigan Spine Surgery Improvement Collaborative: A Model for a Neurosurgical Quality Improvement**

*Jason Schwalb, MD*

### **Introduction:**

Given the costs and scrutiny regarding spine surgery in the United States, both surgeons and insurers are interested in demonstrating outcomes, identifying which patients will not benefit from surgery, and reducing costs, often by reducing complications. In 2013, Blue Cross Blue Shield of Michigan (BCBSM) and Blue Care Network established the Michigan Spine Surgery Improvement Collaborative (MSSIC) as one of the 21 Clinical Quality Initiatives (CQIs) at the time, as part of their Value Partnerships Program.

### **Methods:**

MSSIC focuses on degenerative cervical and lumbar spine surgery, excluding infection, tumors, trauma and deformity. MSSIC currently consists of 28 hospitals and 2 independent Ambulatory Surgical Centers across the state, with rural, suburban and urban centers, private and academic practices. A standardized data set is obtained by data abstractors at the various institutions, funded by BCBSM. Variables include indications, baseline patient-reported outcomes (PROs), surgical and medical history. Outcomes are measured at 90 days, 1 year and 2 years, including complications, reoperation rates, opioid use, tobacco cessation, return to work, and multiple PROs. An integral part of MSSIC is triannual in-person or virtual meetings as well as every other month conference calls with both orthopedic and neurosurgical surgeon champions from each center. Best practices are identified and disseminated.

All surgeons have access to their risk adjusted data and can sign up for push reporting. Both surgeons and hospitals are financially incentivized to meet quality measures.

### **Results:**

As of March 2022, more than 75,000 patients have been entered into the registry. Sixteen peer reviewed papers have been published. One and 2 year patient satisfaction rates approach 80% overall. Between July 2017 and June 2021, there was a 15% reduction in surgical site infection, 16% reduction in unscheduled hospital readmissions within 90 days of surgery, 69% reduction in urinary retention, and 152% increase in ambulation within 8 hours of surgery across the state. Estimated cost savings were \$51 million. Centers have been able to justify additional investments for Spine Coordinators on the basis of the MSSIC infrastructure and findings.

### **Conclusions:**

In addition to functioning as a registry, MSSIC has driven resources and quality in spine surgery for degenerative spinal disease in the state of Michigan. Its unique funding model, supported by BCBSM, serves as an example of how to promote collaboration and incentivize quality that leads to "raising all boats" and decreasing overall costs.

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## **Developing a Prediction Model for Identification of Distinct Perioperative Clinical Stages in Spine Surgery With Smartphone-Based Mobility Data**

*Jang Yoon, MD*

### **Background:**

Spine surgery outcomes assessment currently relies on patient-reported outcome measures, which satisfy established reliability and validity criteria, but are limited by the inherently subjective and discrete nature of data collection. Physical activity measured from smartphones offers a new data source to assess postoperative functional outcomes in a more objective and continuous manner.

### **Objective:**

To present a methodology to characterize preoperative mobility and gauge the impact of surgical intervention using objective activity data garnered from smartphone-based accelerometers.

### **Methods:**

Smartphone mobility data from 14 patients who underwent elective lumbar decompressive surgery

were obtained. A time series analysis was conducted on the number of steps per day across a 2-year perioperative period. Five distinct clinical stages were identified using a data-driven approach and were validated with clinical documentation.

### **Results:**

Preoperative presentation was correctly classified as either a chronic or acute mobility decline in 92% of patients, with a mean onset of acute decline of  $11.8 \pm 2.9$  weeks before surgery. Postoperative recovery duration demonstrated wide variability, ranging from 5.6 to 29.4 weeks (mean:  $20.6 \pm 4.9$  weeks). Seventy-nine percentage of patients ultimately achieved a full recovery, associated with an  $80\% \pm 33\%$  improvement in daily steps compared with each patient's preoperative baseline ( $P = .002$ ). Two patients subsequently experienced a secondary decline in mobility, which was consistent with clinical history.

### **Conclusion:**

The perioperative clinical course of patients undergoing spine surgery was systematically classified using smartphone-based mobility data. Our findings highlight the potential utility of such data in a novel quantitative and longitudinal surgical outcome measure.

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## **Nerve Transfers for C5-6 Palsies after Cervical Spine Surgery: Need for Earlier Referral?**

Eric L. Zager, Stephen Miranda, Jessica Nguyen, Disha Joshi, Zarina Ali

Dept. of Neurosurgery, Perelman School of Medicine, University of Pennsylvania, Philadelphia, PA

*Eric Zager, MD*

### **Introduction:**

C5-6 palsies after cervical spine surgery can occur in 5-10% of cases. Nerve transfer has emerged as a viable strategy for restoring function for patients with persistent weakness, but indications and outcomes remain understudied.

### **Objectives:**

To characterize functional outcomes of patients who underwent nerve transfers for C5-6 palsies after cervical spine surgery at one academic institution.

### **Methods:**

A retrospective chart review was performed to identify patients who underwent nerve transfers for C5-6 palsies after cervical spine surgery between 2013-2021.

Demographics, operative details, electromyography findings, onset and degree of weakness (by MMT), extent of improvement, and length of follow-up were collected. Descriptive statistics were performed, including paired t-tests for pre- and post-operative MMT scores and Pearson chi-squared tests for categorical variables.

### **Results:**

Five patients were identified. Median age was 65 years. Patients were predominantly male (4/5), White (5/5) and non-obese (4/5), with few comorbid conditions. All patients underwent posterior cervical spine surgery (range: 2-6 levels) for degenerative myelopathy and/or radiculopathy, with one combined anterior/posterior case. Three patients had pre-operative weakness that worsened post-operatively. Onset of weakness ranged from 0-5 days postop. All patients had no or trace recovery at time of evaluation by a nerve surgeon (range: 1-16 months). Mean MMT score at time of evaluation was 0.6+0.89 for deltoid and 1.8+1.79 for biceps. Nerve transfers were performed on average at 11.8 months after onset of C5-6 palsy and included triceps branch to axillary nerve and ulnar nerve fascicle to biceps branch of musculocutaneous nerve transfers. Mean postoperative MMT scores in biceps (3.2+1.1) and deltoid (2.6+1.14) significantly improved compared to baseline ( $p=0.012$ ). Follow-up ranged from 4-17 months. For patients with at least six months of follow-up, earlier nerve transfer was associated with improvement in MMT score in recipient muscle groups ( $p=0.046$ ).

### **Conclusions:**

In this small series, nerve transfers restored function for patients with C5-6 palsies after cervical spine surgery. Early referral may improve functional outcomes.

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## **Novel pharmacological targets for the treatment of hydrocephalus**

Satish Krishnamurthy, Jie Li, Jason Grullon, Yimin Shen, E Mark Haacke

*Satish Krishnamurthy, MD*

### **Introduction:**

Hydrocephalus is a poorly understood disorder and is primarily treated with surgery to divert the CSF. Surgical management of hydrocephalus is fraught with complications, emergent shunt malfunctions and infections. We have demonstrated that osmotic gradients are sufficient to cause hydrocephalus in an animal model. Further, we have demonstrated that transport of macromolecules that create this increased

osmotic load in the ventricles are delayed in the presence of hydrocephalus. Our central hypothesis is that macromolecules are eliminated out of the brain primarily by efflux transporters (ABCB1 and/or ABCG2) and a slower clearance results in hydrocephalus due to excess macromolecules remaining in the ventricular CSF.

### **Methods:**

We investigated the effect of modification of efflux transporters in a rat model of intraventricular hemorrhage induced hydrocephalus. Intraventricular hemorrhage was induced using autologous blood in normal rats ( $n=8$ ), Mdr1a (ABCB1 KO) knockout rats ( $n=10$ ) and Mrp2 (ABCB1 over expressed) knockout rats ( $n=9$ ). MRI scans were performed at different time points (Pre-, 5 days, 10 days and 15 days post hydrocephalus induction). We calculated the volumes of the ventricles based on the semiquantitative method using 3D MRI scan data in different animals at different time points. The chart below shows the results with the preinjection baseline ventricular volume for each animal recorded as zero to represent only the increase in percentage of ventricular volume after intervention.

We also investigated in our EPIC dataset of all the pediatric patients with hydrocephalus using SlicerDicer software. We looked at the association of concurrent use of ABCB1 (p-glycoprotein) inhibitors and surgery for hydrocephalus (shunt revisions)

### **Results:**

P-glycoprotein knock out (Mdr1a KO) animals had a statistically significant ( $p<0.05$ ) increased ventricular volume while compared to normal animals. The clearance times were also increased compared to normal animals without intraventricular hemorrhage. P-glycoprotein overexpressed (Mrp2 KO) animals had a statistically significant ( $p<0.05$ ) smaller ventricular volume compared to the p-glycoprotein knock out animals on day 10 but not on day 15. The clearance times for these overexpressed animals were closer to normal animals without intraventricular hemorrhage. In the clinical data set there was a significant association of taking concurrent ABCB1 inhibitors and surgery.

### **Conclusions:**

Efflux transporters appear to be key modulators of experimental hydrocephalus. Knockout of ABCB1 worsens hydrocephalus while overexpression improves hydrocephalus. Preliminary analysis of clinical data suggests that this might be relevant in human hydrocephalus as well. Future studies will focus



on determining whether these efflux transporters can be targeted effectively to treat hydrocephalus pharmacologically.

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### **A Novel Web-based Platform and Mobile Phone Application to Evaluate Surgical Competence in Graduate Medical Education.**

Nickalus Khan, MD., L. Madison Michael, MD., Jeffrey Sorenson, MD.  
Department of Neurosurgery, University of Tennessee  
Memphis

#### ***Jeffrey Sorenson, MD***

We present our initial experience with a mobile phone application designed to track neurosurgical residents' acquisition of procedural and cognitive skills through self-assessment and evaluations from attending physicians, resident peers, and blinded video reviewers. Surgical procedures are decomposed into component skills that are evaluated individually using a clearly defined five point scale. Resident learning curves for each of these skills are compared to expectations, which can vary by skill. Different procedures may share common skills, which can be measured globally or in the context of a specific procedure. A built-in curated video handbook demonstrates how to perform each skill and how to recover when difficulties arise. Each resident may upload videos of their performances for blinded review and build a personal library demonstrating their competence.

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### **New insights into the Oscillatory Neural Dynamics in Sensorimotor Cortex Related to Different Tactile Stimulations**

#### ***Sujit Prabhu, MD***

#### **Objective:**

The current gold standard for intraoperative identification of the sensorimotor cortex is somatosensory evoked potentials. The use of strip electrodes suffers from poor spatial resolution and misinterpretation of the evoked response. This study aims to investigate the feasibility of passive functional mapping to define the sensorimotor area in both the awake and anesthetized states.

#### **Method:**

Electrocorticogram (ECoG) was recorded in the awake and anesthetized state from high-density subdural hybrid grids placed over the sensorimotor area in four

patients with brain tumors, two of which the tumor invaded the primary somatosensory (S1) and primary motor area (M1), respectively. During the recordings, over 100 vibrotactile stimulation for 500ms and pressure stimulation (up to 50g) for 2s were applied to the index finger, the thumb, and palm with 2-4s intervals. Spectral components of the ECoG were examined with time-frequency analysis and their topography were visualized over a 3D cortical mesh rendered from preoperative MRI scan of individual subjects.

#### **Results:**

We observed gamma response (60-300Hz) to the tactile stimulation in the anesthetized and awake state that started 50ms after the stimulation onset and lasted up to 600ms. In each state, the gamma activity defined S1 for both vibrotactile and pressure stimulation where it was more pronounced in the awake state than in the anesthetized state (Vibrotactile:  $1.10 \pm 0.89$   $\Delta$ dB, mean  $\pm$  S. D, paired t-test,  $p = 0.0450$ ; Pressure:  $1.98 \pm 0.96$   $\Delta$ dB, paired t-test,  $p = 0.0349$ ). The gamma activities were also highly spatially correlated between states for the tactile stimulation (Vibrotactile:  $\rho = 0.83 \pm 0.09$ , Pressure:  $\rho = 0.85 \pm 0.09$ ), and between the vibrotactile and pressure stimulation in each state (Anesthetized:  $\rho = 0.73 \pm 0.18$ , Awake:  $\rho = 0.81 \pm 0.08$ ).

#### **Conclusion:**

Passive functional mapping using vibrotactile and pressure accurately defined the somatosensory area rapidly in the awake and anesthetized states with observed gamma activity. This information can be reliably used for planning tumor resection in perirolandic brain tumors.

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### **Lesion evolution on MRI following MR-Guided Focused Ultrasound Thalamotomy**

#### ***Craig Rabb, MD***

The use of MR-Guided Focused Ultrasound (MgFUS) to treat Essential Tremor has recently emerged as a viable treatment option for patients with disabling tremor who are not candidates for Deep Brain Stimulation. Presently, it is only approved for unilateral lesioning, with the goal of creating a permanent thalamotomy. In the course of treating 10 patients, lesion appearance on MRI was evaluated both at the time of treatment, as well as on follow-up MRI performed at least 1 month post-treatment. These findings were also correlated with treatment temperatures achieved, as well as tremor relief via CRST. We conclude that lesion appearance may evolve considerably, often

resulting in very subtle findings on follow up imaging. Nevertheless, patients can continue to have durable tremor relief in spite of these imaging changes. Longer term follow up of durability of tremor relief in relation to these imaging findings will be important to determining optimal treatment temperatures.

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## **Surgical Revascularization for Vertebrobasilar Disease: Indications and Techniques**

**Fady Charbel, MD**

### **Background:**

Vertebrobasilar stenosis associated with a low flow state, is associated with a high risk of stroke recurrence. While further work is needed to identify the optimal strategy for intracranial disease, mostly due to the higher risks of interventions in that location, surgical interventions on the extracranial V1 to V3 segments are lower risk, effective, yet less familiar to most than endovascular techniques.

### **Methods:**

This report reviews a selected retrospective series of patients with symptomatic vertebrobasilar disease treated with surgical approaches to the V1 to V3 segments of the vertebral artery.

### **Results:**

Eighteen patients presented with variable symptoms related to vertebral artery compromise. Surgical interventions were directed to the V1 (n=4), V2 proximal (n=4), V2 distal (n=8), V3 (n=1), or combined with other surgical or endovascular interventions (n=3).

No patient had worsening in mRS, and all but one had resolution and/or no recurrence of their pre-operative symptoms

### **Conclusion:**

Surgical Revascularization techniques for Vertebrobasilar Disease are effective albeit likely underutilized. Increased knowledge of the indications and performance of these procedures may lead to wider implementation and potentially beneficial outcomes.

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## **Treatment of Symptomatic Cerebrovascular Atherosclerosis**

Nikolaos Mouchtouris<sup>1</sup>, MD; Fadi Al Saiegh<sup>1</sup>, MD; Karim Hafazalla<sup>1</sup>, MD; Sumeet Multani, MD; Lohit Velagapudi<sup>1</sup>, BS; Omaditya Khanna, MD<sup>1</sup>; Victoria Schunemann, MD<sup>1</sup>; Thana Theofanis, MD<sup>2</sup>; Nabeel Herial, MD<sup>1</sup>; M. Reid Gooch<sup>1</sup>, MD; Pascal Jabbour<sup>1</sup>, MD;

Robert Rosenwasser<sup>1</sup>, MD; Stavropoula Tjoumakaris<sup>1</sup>, MD

**Stavropoula Tjoumakaris, MD**

### **Introduction:**

Endovascular treatment for cerebrovascular atherosclerosis fell out of favor due to the high morbidity associated with older stent technology. As a result, there is a paucity of treatment options for patients with recurrent ischemic strokes despite being on maximal medical therapy.

Methods: Retrospective analysis of patients with recurrent ischemic stroke due to cerebrovascular atherosclerosis despite maximal medical therapy who underwent cerebral angiography for Resolute Onyx stent placement at our institution from January to December, 2021.

### **Results:**

A total of 22 patients were included in the study with a mean age of  $66.5 \pm 9.4$  years old. Twelve (54.5%) patients underwent stenting for intracranial disease and 10 (45.5%) for extracranial disease. The stented vessels included: petrous and cavernous ICA, M1, and V1, V2, V4. The median preoperative intracranial vessel stenosis was 76.5% (IQR:69.3-82.0%) and the median reduction was 65.3% (IQR 56.6-73.3%). The median preoperative extracranial vessel stenosis was 79.6% (IQR:71.8-87.5) and the median reduction was 74.5% (IQR 65.6-80.0%). The median procedural time, contrast dose and fluoroscopy time were 64.5 minutes (IQR 50.0-82.8), 100cc (IQR:85.0-150.0), 20.8 minutes (IQR: 12.4-29.3) respectively. There were no periprocedural complications associated with stenting. Eleven (50.0%) patients were seen in follow-up at a median 42.0 days (IQR: 12.0-295.0) after surgery and only one patient presented to the hospital with a transient ischemic attack and imaging revealed stent patency.

### **Conclusion:**

Our experience with the Resolute Onyx stent for both intracranial and extracranial atherosclerosis demonstrates the feasibility and safety of use in this patient population. We provide a detailed account of our experience and technical nuances. Larger scale studies are warranted to further investigate the application of this device to cerebrovascular atherosclerosis.

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## **Paracavernous transtentorial resection of pontine cavernous malformation.**

***Aclan Dogan, MD***

We present a video of surgical removal of pontine cavernous malformation in a 39 year old male patient with progressive worsening of left side weakness causing difficulty in walking and fine motor hand activities. MRI of brain showed 28 X18 X 20 mm exophytic cavernous malformation centered in right aspect of the pons and extending into the inferior right midbrain. It is located in the region of right trigeminal root entry/exit zone as well as the right corticospinal tract. Cavernoma was removed in gross total by the right paracavernous transtentorial approach. Surgical technique will be discussed with operative video presentation.

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## **Maximal Safe Resection in Thalamic Gliomas improves survival: Single-Center Experience**

Department of Neurosurgery, University of Wisconsin-Madison, School of Medicine and Public Health, Madison, WI

***Mustafa Baskaya, MD***

### **Objective:**

Thalamic gliomas (TGs) are deep-seated, difficult-to-access tumors, surrounded by vital neurovascular structures. Consequently, TGS are commonly regarded as inoperable due to their historically high operative morbidity. Although maximal safe resection (MSR) has become the treatment standard for lobar and even deep seated medio-basal temporal and insular gliomas, thus far this eloquent location has precluded the same surgical strategy for TGs. Biopsy with adjuvant treatment has long been the mainstay management strategy. We hypothesize that MSR can be achieved with low morbidity and mortality in TG patients, and that this can improve outcomes in this group of patients.

### **Methods:**

A retrospective single-center review was performed of all TG patients from 2000-2020. Patients with at least 80% tumor resection were included. Clinical data, imaging studies and pathological reports were obtained. Univariate and multivariate analyses identified factors influencing prognosis. Results: A total of 42 patients (26F, 16M) were included. Mean age was  $35.0 \pm 21.4$  (median 30, range 3-73) years. Twelve patients (29%) were in the pediatric age group. The median maximal tumor diameter was

45 mm (range 19–70 mm). Eighteen patients (43%) had a prior tumor biopsy – the ultimate diagnosis was changed in 39% of these patients following microsurgical resection. The most commonly used surgical approaches were the transtemporal (29%), anterior interhemispheric transcallosal (25%) and the superior parietal lobule (25%). The extent of resection was gross-total in 35% and subtotal in 65%. Low-grade tumors (grade I-II) comprised one-third of the study group whereas more than half of the patients (52%) had glioblastoma. There was no operative mortality. Although temporary postoperative motor deficits were observed in 12 patients (28.6%), all improved during the early postoperative period except one patient who remained with mild hemiparesis. Two year survival was 90% in patients with low grade tumors and 15% in high-grade tumors. Multivariate analysis revealed that histological grade, age, and extent of resection were independent prognostic factors associated with survival.

### **Conclusion:**

Management of TGs is challenging with attempted resection avoided by most neurosurgeons, especially for high-grade tumors. However, the results reported here demonstrate improved outcomes with surgical resection, particularly in younger patients with low-grade tumors. Therefore, we advocate for maximal safe resection for TGs using carefully selected surgical approaches, contemporary intraoperative adjuncts, and meticulous microsurgical techniques.

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## **Cutaneous malignant melanoma mimicking Malignant Peripheral Nerve Sheath Tumor (MPNST) within Meckel's cave: Utility of Next-Generation DNA Sequencing for Diagnosis**

Danielle D Dang MD MA, Olivia Gilbert BS BFA, Mahtab Tehrani MD, Nilesh Vyas MD

***Nilesh Vyas, MD***

### **Introduction:**

Malignant Peripheral Nerve Sheath Tumors (MPNST) and metastatic melanoma in Meckel's cave are exceptionally unusual. Desmoplastic neurotropic metastatic melanoma (DNM), a rare variant, frequents the skull base via perineural invasion of the trigeminal or facial nerves in the setting of previous head/neck cutaneous malignancy, while MPNST arises directly from cranial nerve sheath fibers. Shared embryonic lineage of neural crest origin renders significant histopathologic overlap and limited diagnostic distinction. Given poor prognosis and varying therapeutic regimens for intracranial MPNST



and melanoma, utilization of Next-Generation DNA Sequencing (NGS) to detail genetic and immunological profiles, confirm diagnosis, and guide neuro-oncologic therapy is vital.

### **Objectives:**

To present a case of metastatic melanoma mimicking MPNST within Meckel's cave and to emphasize early diagnosis with NGS

### **Methods:**

A 73-year-old male presented with subacute hallucinations and right abducens palsy. He had no history of melanoma but reported a nondescript family history of skin cancer. He harbored no suspicious integumentary lesions. Neuroimaging demonstrated a solitary, bilobed, gadolinium-enhancing mass in Meckel's cave extending to the prepontine cistern with an amelanotic appearance on unenhanced sequences (Figure 1). No perineural enhancement of the postganglionic trigeminal nerve or maxillofacial structures was evident nor was osseous foraminal expansion on CT. The patient underwent a right-sided subtemporal craniotomy with transpetrosal approach for a suspected trigeminal schwannoma.

### **Results:**

Macroscopic appearance of the tumor was non-pigmented and suggestive of nerve sheath tumor. Histopathology revealed a high-grade spindle-cell sarcomatoid neoplasm with neurocristic differentiation (Figure 2). Immunohistochemical staining was positive for S100 and SOX10 with no reactivity evident for BCL2, CD34, GFAP, HMB45, Melan A, desmin, or pancytokeratin. Initial diagnosis was interpreted as MPNST.

The patient underwent 27 fractions of 200Gy external beam radiation. Eventually, NGS led to an integrated diagnosis of poorly differentiated metastatic cutaneous melanoma based on the sarcoma methylation classifier and mutation profile (Figure 3). The patient expired 3 months post-operatively before immunotherapy could be initiated.

Literature review yielded 18 articles with 26 cases of malignant melanoma infiltrating Meckel's cave (Figure 4). 92.3% cases represented DNM with perineural trigeminal invasion. The remaining cases were primary melanoma with one association to NF-1. DNM presented with extensive post-ganglionic trigeminal nerve enhancement, pterygoid and orbital infiltration, and an amelanotic radiographic appearance. Two cases depicted histopathologic mimicry of MPNST in which discovery of cutaneous head/neck involvement occurred 9 months after skull base tumor resection in

one case. NGS was inconsistently reported.

### **Conclusion:**

We present a challenging case of metastatic Meckel's cave melanoma treated as presumptive trigeminal MPNST. Our case represents the second case of MPNST mimicry in Meckel's cave without a history of cutaneous melanoma. A lack of enhancement of post-ganglionic cranial nerves and osseous expansion of maxillofacial foramina precluded consideration for classic DNM on radiography. Histopathology was inconclusive. NGS was ultimately critical for accurate diagnostics and offering result-driven guidance for FDA-approved immunotherapies despite the patient's accelerated demise. NGS should be performed at the time of initial specimen collection for suspected cranial nerve sheath tumors, particularly those with unknown dermatologic history or melanoma risk factors.

### **Figures:**

#### **Figure 1:**

MRI Brain, Axial views. (A) T1-weighted unenhanced view of T1- hypointense lesion. (B) T1-weighted Gadolinium-enhanced view of the same lesion within Meckel's cave showing infiltration of the adjacent cavernous sinus (yellow arrow) and prepontine cistern (blue arrow). (C) T2-weighted FLAIR sequence showing mild associated pontine edema (red arrow).

#### **Figure 2:**

Histopathology demonstrating sarcomatous spindle-cell neoplasm (A) with high mitotic activity (B).

#### **Figure 3:**

Table depicting NGS results. Mutations in bold are highly suggestive of dedifferentiated melanoma.

#### **Figure 4:**

PRISMA diagram for systematic literature review of all malignant melanomas within Meckel's cave documented within the English literature.

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### **Comparison study reviewing early experience on spine robotics technology using closed vs. open platforms.**

***Anthony Sin, MD***

#### **Introduction:**

Robotics technology in spine surgery is at its early stages. Future direction as it develops into a more mature component of daily spinal procedures is yet to be determined.

#### **Methods:**

Surgical cases utilizing two different types of robots were compared from January 2021 to February 2022. Mazor-X Stealth (Medtronic) and Cuvis-spine (Curexo, South Korea) were available during the study period. Charts were reviewed for demographics and surgical details.

#### **Results:**

Out of 90 consecutive robotic spine surgeries, 80 cases were done with Mazor-X and 10 cases were done with Cuvis. The first Cuvis case was in November 2021. There were no direct complications related to robots. 45 MIS cases, including 2 level DLIF with percutaneous screws, and 22 pelvic fixations using S2-A1 screw cases were done using Mazor-X. 5 MIS and 5 open cases were done using Cuvis-spine. Pre-operative CT scan was utilized for Mazor-X open cases with intraoperative C-arm fluoroscopy registration while O-arm spin was done for MIS cases after placement of interbody cages. Every Cuvis-spine case was done utilizing O-arm spin as pre-operative CT planning is not yet available.

#### **Conclusions:**

Major implant companies will increase their market share as more surgeons adapt to robotic technologies since their robots will be customized to their own

hardware. Open platform robot will be more flexible for surgeons to utilize personally preferred hardware implants.

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## **Surgical Management of Vestibular Schwannoma (Acoustic Neuroma): Facial Nerve Outcomes, Radiographic Analysis, Complications, and Long Term Follow up in a Series of 420 surgeries.**

Authors: Nickalus R. Khan M.D.1, Turki Elarjani M.D.1, Aria M. Jamshidi M.D.1, Stephanie H. Chen M.D.1, Clifford S. Brown M.D.2, Josh Abecassis M.D.1, Michael A. Silva M.D.1, Victor M. Lu M.D.1, Monica Diaz-Kanelidis M.D.3, Rita Bhatia M.D.3, Michael Hoffer, MD2, Adrien Eshraghi, MD2, Christine Dinh, MD2, Simon Angeli, MD2, Fred Telischi, MD2, Jacques J. Morcos M.D., FRCS1,2

### **Affiliations:**

1. Department of Neurosurgery, University of Miami Miller School of Medicine
2. Department of Otolaryngology, University of Miami Miller School of Medicine
3. Department of Radiology, University of Miami Miller School of Medicine

### **Jacques Morcos, MD**

### **Introduction:**

Acoustic neuroma surgery remains challenging. Facial nerve preservation rates and correlating factors vary among different series. The purpose of this study is to retrospectively evaluate the clinical and surgical outcomes of a large series from North America over 20 years, under the care of one neurosurgeon and several neurootologists.

### **Methods:**

After institutional review board approval (IRB # 20170149) a retrospective review of the senior author's personal case logs to identify patients who had operations for vestibular schwannoma was performed. The preoperative clinical notes, operative record, preoperative and post-operative imaging and long-term clinical follow up notes were then evaluated. Facial nerve outcomes were reported according to the House Brackmann (HB) scale.<sup>14</sup> A good facial nerve outcome was defined as a HB score of I or II. Hearing outcomes when available were reported using the AAO-HNS Committee on Hearing and Equilibrium classification system.<sup>15</sup> Patients who underwent observation or radiosurgery only were excluded from this study.

### **Results:**

A total of 415 patients underwent 420 surgeries, with a mean age of 51.3 yrs, M/F: 177/235, Left/Right: 193/210, NF2/non-NF2: 13/402. Preop hearing was AAO-HNS grades: A+B/C+D/Unknown: 94/185/161. Preop Facial Nerve function HB scores: 1+2 / 3+4+5+6 / Unknown: 383/11/17. Prior radiosurgery or prior microsurgery was given in 8.7% and 5.6%, respectively. When imaging was available to review, the following factors were analyzed and quantified: Tumor dimensions, IAC anterior wall length, IAC tumor extension, CPA tumor extension, IAC angle, anterior and posterior petrous distance, brainstem edema, cystic change, jugular bulb position, Koos grade (Grade 1=10.2%; 2=20.2%; 3=28.0%; 4=41.6%), hydrocephalus. Surgical approaches: Retrosigmoid (62.6%), Translabyrinthine (32.1%), Middle fossa (4.3%). Facial nerve Stimulation threshold at the end of the procedure was 0.05mA in 85.9% of the procedures. Surgical complications will be detailed. Mean clinical follow-up was 3.75 years Facial nerve outcomes immediately postop and at final follow-up were HB 1/2 in 75% and 86%, respectively. Univariate analysis comparing good (HB1/2) facial nerve outcome to poor outcome showed the importance of: preop HB score, prior surgical resection, stimulation threshold, descriptive facial nerve consistency, CPA extension and tumor volume. But on multivariate analysis, only facial nerve stimulation threshold persisted as a predictive variable. Gross total (GTR) and Near total resection (NTR) was achieved in 82%. Among the patients with residual tumor, 15% demonstrated further growth.

### **Conclusion:**

With a general strategy of attempting gross total resection when judged feasible safely intraoperatively, the rate of good (HB-I & HB-II) facial nerve function at long term follow up is 86% which improves from 75% in the immediate postoperative period. There was a significant correlation with CPA extension, tumor volume, facial nerve stimulation threshold, facial nerve consistency, preoperative facial nerve function, and history of a prior resection. Tumor recurrence remains significantly higher after subtotal resection. We believe the data supports a continuation of a strategy of general intent of gross total resection, greatly modifiable by intraoperative findings and judgement.

**Management of 1000 vestibular schwannomas (acoustic neuromas): surgical and Gamma Knife radiosurgery results with an emphasis on facial nerve preservation and complication avoidance.**

**Michael Sisti, MD**

Major improvements in 1990's for the treatment of patients with acoustic neuromas benefited from the advances and the widespread adoption of high-resolution contrast MRI imaging of the brain, improved microsurgical techniques and the increased adoption of radiosurgery. Twenty-five years ago, Samii et al published 3 papers in Neurosurgery on his methods and outcomes on 1000 AN operated on from 1973 to 1993 detailing his results for achieving tumor removal by microsurgery with cranial nerve preservation and complication avoidance.

Adding radiosurgery to the integrated management strategy of ANs from 1998 to 2022 over 1000 AN were treated with either GKS or microsurgery by the same neurosurgeon (MBS) at a single institution (Columbia) principally as a function of tumor size with a focus on intact facial nerve function (HB 1 or 2) and complication avoidance. The 10-year combined surgical and radiosurgery results from 1998 to 2008 (published in JNS 2011) and the GKS only results from 1998 to 2015 (published in NS 2019) were first presented at previous SUN meetings from a group of 701 patients treated solely by the author between 1998 and 2015.

Currently the consecutive 23-year series encompasses over 1000 patients treated by the same surgeon(MBS) with 490 large tumor surgeries (tumors mostly over 3 cm) and 660 GKS treatments (tumors mostly under 2.2cm).

A preliminary review of the long-term strategy since 1998 and the results particularly as it relates to intact facial nerve function (HB1 or 2) and complication avoidance will be presented. An update on the long-term results of tumor control and the use of GKS for tumor recurrence since 1998 will be discussed.

**Advantages and Disadvantages of Hybrid Operating Rooms in Neurosurgery**

V.Tronnier<sup>1</sup> and Peter Schramm<sup>2</sup>

<sup>1</sup>Dept. of Neurosurgery, University Hospital Lübeck, Germany

<sup>2</sup>Dept. of Neuroradiology, University Hospital Lübeck, Germany

**Volker Tronnier, MD**

**Objective:**

An Hybrid OR, especially adapted for neurosurgical needs is considered the OR of the future. A single surgical workspace that combines (neuro-)radiological imaging equipment with a multifunctional surgical table, allows clinicians to diagnose and treat vascular malformations and other entities in a single location, reducing risk and delays, improving patient safety, and ultimately reducing costs. However very often the Hybrid OR is primarily used by cardiologists and cardiac surgeons and therefore especially designed for their needs.

Nevertheless these OR's can be used for combined neurovascular and endovascular cases. Different advantages and disadvantages have to be considered for vascular neurosurgeons as well as endovascular interventionalists (neuroradiologists).

**Methods:**

5 consecutive illustrative cases with AVM's and dAVF's operated between 2020 and 2021 are described and the advantages of an Hybrid OR are illustrated. On the other hand special technical difficulties and problems were encountered for both disciplines. For intraoperative angiography an Azurion 7 Clarity FD20, (Philips Healthcare, Best, The Netherlands) with Flat detector Image Guided System was used. An „targeted“ angiography was carried out in 2 planes preoperatively and a second one, when the surgeon considered the procedure to be finished. If remnants of the AVM or dAVF were visible, the surgeon continued and a third final angiography ends the surgical intervention. Otherwise the common surgical techniques with neuronavigation, neuromonitoring, intraoperative fluorescence (ICG) were applied.

**Results:**

The Hybrid OR in the described cases enabled the neurovascular team to control intraoperatively the success of the surgical procedure (total removal of the AVM or dAVF). Minor remnants detected by intraoperative angiography could be resected or occluded either surgically or endovascularly. The procedure was lengthened by the intraoperative



angiography itself and the necessary preparations (removal of metallic instruments, special draping etc.) On the other hand the intraoperative control of the surgical result spared an angiography postoperatively and a possible second procedure.

**Conclusion:**

A neurosurgical Hybrid OR can be advantageous for selected, especially pretreated cases even in an unfamiliar environment. If an Hybrid OR is planned in an hospital, the neurosurgeon and endovascular interventionalist should be involved in the design of the setting for their needs.

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**Human Brain Tumors - Molecules and Models**

*Atom Sarkar, MD*

The classification of gliomas by J.W. Kernohan was first presented 1949. It has been seven decades since his description, and while research towards an understanding of glioma biology has led to rich insights, overall improvements in clinical outcomes typically have been modest. Part of the problem has been the protean nature of these tumors, and another part has been creating models which capture the behavior of such malignancies. This talk will highlight personal insights gained over the last 15 years to identify critical molecules and a range of glioma models that guide our groups current efforts towards merging basic science insights into clinically relevant applications.

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**Acute Flaccid Myelitis**

*Allan Belzberg, MD*

**Background:**

Acute flaccid myelitis (AFM) is a rare disease that tends to target younger patients. The virus attacks lower motor neuron cell bodies in the ventral spinal cord resulting in a patchy flaccid paralysis. Nerve transfers have become the surgical intervention of choice. Targeting has included upper and lower extremity deficits in addition to phrenic nerve.

**Objective:**

To review our institutional experience with AFM in addition to a systematic review of the literature. Results: Peer reviewed published data in addition to our own experience has been summarized to include results on approximately 50 patients suffering from AFM. 50% of patients achieved a good outcome for shoulder. Elbow flexion was achieved in 90%. Lower extremity results as well as phrenic reinnervation are less clear and require further analyses. Complications are almost nil.

**Conclusions:**

Nerve transfers appear to be useful and safe for the treatment of lower motor neuron deficits in AFM patients. Lower extremity and phrenic nerve reinnervation remain possible but as yet, unproven.

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# Exhibitors

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## PLATINUM

Zeiss

Longevity

Altus Spine

Penumbra

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## GOLD

Depuy

Takayama Instrument

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## SILVER

Aegis Spine



l o n g e v i t i



Penumbra 

The logo for Penumbra, featuring the word 'Penumbra' in red and a red circle containing a white stylized 'P'.