Western Neurosurgical Society
69th Annual Meeting

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Western Neurosurgical Society
69th Annual Meeting

2023 LEARNING OBJECTIVES

The purpose of this meeting is to provide an update in the basic and clinical Sciences underlying neurosurgical practice through lectures, discussions, interactive sessions with neurological surgeons, neurologists, neuroradiologists, and other allied health personnel.

Upon completion of this program, participants should be able to:

- Describe recent advances and ongoing challenges in the treatment of degenerative spinal disease.
- Explain opportunities and limitations of neurosurgical care in low- and middle-income countries.
- Identify the current management of patients with cerebrovascular disease using both open and endovascular techniques.
- Summarize novel techniques in the treatment of brain tumors.
- Practice clinical outcomes in the management of pediatric patients with neurosurgical diseases.
- Explain the challenges facing neurosurgeons regarding the decreasing labor force.
- State the regulatory, financial, and administrative changes in healthcare that impact outcomes and cost-effective care.

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Marco Lee, President-Elect
David Pitkethly, Past-President
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Moustapha Abou-Samra
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Marvin Bergsneider
Christine Smith

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CME COMMITTEE (ad hoc)
Odette Harris,Chair

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2023 WNS Annual Meeting Guests

Mitchel Berger, MD	Cloward Medalist	WNS
Kelley Skeff, MD, PhD	Prolo Lecturer	WNS
Patrick Webster	Local Interest Lecturer	WNS
Katie Orrico, Esq.	Inaugural Randy Smith Lecturer	WNS
Jacob Young, MD	Basic Science Resident Award	WNS
Gianna Fote, MD, PhD	Clinical Science Resident Award	WNS
Florence Smith, RN	Guest of Honor	WNS

Ausaf Bari, MD	Nominee	Justin Dye
Krista Greenan, MD	Nominee	John McVicker
Alex Khalessi, MD	Nominee	Justin Dye
Won Kim, MD	Nominee	Marvin Bergsneider
Andrew Ko, MD	Nominee	Jason Hauptman
Barbara Lazio, MD	Nominee	Marvin Bergsneider
Brian Lee, MD	Nominee	Steven Giannotta
Michael Lim, MD	Nominee	Gordon Li
Benjamin Yim, MD	Nominee	Ciara Harraher

Jared Ament, MD	Candidate	Amir Vokshoor
Samuel Browd, MD	Candidate	Jason Hauptman
Abhineet Chowdhary, MD	Candidate	David Newell
Charles Cobbs, MD	Candidate	Adair Prall
Geoffrey Colby, MD	Candidate	Linda Liau
Anthony DiGiorgio, DO, MHA	Candidate	Moustapha Abousamra
Daniel Nagasawa, MD	Candidate	Jason Hauptman
Giyarpuram Prashant, MD	Candidate	Mark Sedrak
Rima Rindler, MD	Candidate	Jay Morgan
Jacob Ruzevick, MD	Candidate	Jason Hauptman
Rudolph Schrot, MD	Candidate	J. Paul Muizelaar
Brian Hanak, MD	Candidate	Justin Dye
Namath Hussain, MD	Candidate	Justin Dye
Jeff Steinberg, MD	Candidate	Hoi Sang U
Jeremiah Johnson, MD	Candidate	Marvin Bergsneider

Diana Chang, MD	Resident
Spencer Twitchell, MD	Resident
Tim Yee, MD	Resident
John Yue, MD	Resident
Ryan Jamiolkowski, MD	Resident
Shivani Baisiwala, MD	Resident
Jeremy Guinn, MD	Resident
Rajeev Sen, MD	Resident

Philip Downey, MD	Professional Guest	Farrokh Farrokhi
David Gonda, MD	Professional Guest	Jason Hauptman
Tina Canner-Peterson, APN	Professional Guest	Jay Morgan
Theodore Hole, MD	Professional Guest	Moustapha Abousamra
Jee Lee, APN	Professional Guest	Jay Morgan
Michael Karsy, MD	Professional Guest	Phillip Taussky
Jennifer Price, APN	Professional Guest	Jay Morgan
Ghaus Malik, MD	Professional Guest	Jay Morgan
Fredrick Todd, MD	Professional Guest	Jay Morgan
Chris Woolley, MD	Professional Guest	Jay Morgan

Austin Morgan & Kerry-Ann Pinard	Guest	Jay Morgan
Jayson & Ashley Hannah Morgan	Guest	Jay Morgan
Emerie & Aerelyn Morgan	Guest	Jay Morgan

JOINT PROVIDERSHIP ACCREDITATION STATEMENT:

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 Western Neurosurgical Society. The AANS is accredited by the ACCME to provide continuing medical education for physicians.

DESIGNATION STATEMENT

The AANS designates this live activity for a maximum of **12.0** AMA PRA Category 1 Credits™. Physicians should claim only the credit commensurate with the extent of their participation in the activity.

JOINT PROVIDERSHIP DISCLAIMER

Before the program, anyone in control of the educational content of this activity will disclose the existence of any financial interest and/or the relationship they or their significant other have with the manufacturer(s) of any commercial product(s) to be discussed during their presentation. Disclosures will be included in the final program.

The material presented at the Western Neurosurgical Society, 69th Annual Meeting has been made available by the Western Neurosurgical Society and the AANS for educational purposes only. The material is not intended to represent the only, nor necessarily the best, method or procedure appropriate for the medical situations discussed, but rather it is intended to present an approach, view, statement, or opinion of the faculty, which may be helpful to others who face similar situations.

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

Neither the AANS nor the Western Neurosurgical Society makes any statements, representations or warranties, whether written or oral, regarding the Food and Drug Administration (FDA) status of any product used or referred to in conjunction with any course, seminar or other presentation being made available as part of Western Neurosurgical Society 69th Annual Meeting. Faculty members shall have sole responsibility to inform attendees of the FDA status of each product that is used in conjunction with any course, seminar or presentation and whether such use of the product is in compliance with FDA regulations.

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Before the program, anyone in control of the educational content of this activity will disclose the existence of any financial interest and/or the relationship they or their significant other have with the manufacturer(s) of any commercial product(s) to be discussed during their presentation.Disclosures will be included in the final program.

Speakers, paper presenters/authors and staff (and the significant others of those mentioned) who have disclosed a relationship* with commercial interests whose products may have a relevance to their presentation are listed below.

*Educational content planner of this meeting

NAME	DISCLOSURE	TYPE OF RELATIONSHIP
Frank Hsu, MD	Yes	AquaTex (Co-Founder, Koh-Young (Consultant)
Brian Lee, MD	Yes	Blackrock (consultant), Clearpoint Neuro (Consultant), NeuroPace (DSMB member)
Geoffrey Colby, MD	Yes	Stryker Neurovascular (Consultant), MicroVention (Consultant), Medtronic (Consultant), Rapid Medical (Consultant, J&J/ Cerenovus (Consultant)
Linda M. Liau, MD, PhD	Yes	ClearPoint Neuro (Board of Directors, Shareholder), Northwest Biotherapeutics (Consultant)
Michael Karsy, MD	Yes	Altus (Consultant, Thieme (Royalties)
Gary Steinberg, MD, PhD	Yes	Sanbio (Consultant), Zeiss (Consultant), Surgical Theater (Consultant, Peter Lazic-US (Royalties)
Abhineet Chowdhary, MD	Yes	SI Bone (Consultant)
Bruce McCormack, MD	Yes	Providence Medical Technology (Board Member)
Jason Hauptman*, MD, PhD	Yes	Medtronic (Consultant), BK Medical (Consultant), Brainlab (Consultant)
Anthony DiGiorgio, MD	Yes	Mercatus Center at George Mason University (Grant Fundings), DePuy Synthes (Grant Fundings), National Footbal League (Consulting Fees)
Richard B. Chua, MD	Yes	Medtronic Spine (Consultant)
Marco Lee, MD, PhD	Yes	J&J (Consultant), Stryker (Consultant)
Michael Lim, MD, PhD	Yes	Arbor (Research support/Grant), Bristol Myers Squibb (Research support/Grant/ Consulting), Accuray (Research Support/ Grant), Biohaven (Research Support/Grant/ Consulting), Urogen (Research Support/ Grant), VBI (Consulting)

Speakers, paper presenters/authors and staff (and the significant others of those mentioned) who have reported they do not have any relationships with commercial interests:

Brian Hanak, Andrew Ko, Charles Cobbs, Timothy Yee, John Yue, David Westra, Ray Chu, Laura Prolo*, Jared Ament, Barbara Lazio, James Ausman, Giyarpuram Prashant, Jacob Ruzevikc, David Gonda, Marvin Bergsneider, Rima Rindler, Jeffrey Steinberg, John A. Prall, Thomas Scully, Katie Orrico, Namath Hussain, Justin Dye*, Jacob Steward Young, Jay Morgan*, Charles Nussbaum, Shivani Baisiwala, William Loudon, Mitchel S. Berger, Ryan Jamiolkowski, Diana Chang, Jeremiah Johnson, Estrada Bernard, Spencer Twitchell, Andrew Little*, Mark Sedrak*

Donald J. Prolo, M.D.

Donald Prolo has been a member of the WNS since 1974 and an almost constant attendee at our annual meeting.

To anyone who has known Don Prolo over the past few decades, his love of classical thinking and values stands out as a real weathervane for who he is and what he stands for.

Don has been a champion of physician control of patient care as compared to what has become control by government and insurance companies. He gallantly tried, where no others ever went, to get a California based Sherman antitrust exemption so docs could gather together and bargain with the government and the insurance companies for their services. He has continued to work on maintaining physician independence and loudly laments the erosion of private practice with now half of physicians employed by commercial interests.

As he said in his WNS Presidential address in 2002, it is *". . . a citizen's natural right to rebel against unjust positive laws and determinations not made with respect to antecedent principles of natural justice. Coercive threats of fines, sanctions, incarcerations are forces against American medicine without moral authority."* He went on to say, *"In the first two books of the Republic, Plato raised the question why should one be just in his actions toward others or in relation to the community in which he or she lives? The answer lies in the fact that the moral virtues of prudence, temperance, courage and justice underlie happiness, the primary good we desire for ourselves and others."*

In the pursuit of the above values, Don and his wife Joanne have endowed an annual lecture, the Prolo Lecture, to be delivered by diverse speakers addressing professionalism and ethics in medicine.

Prior Prolo Lecturers

2021 Robert Phillips, Jr., M.D., MSPH
Executive Director, Center for Professionalism & Value in Health Care of the American Board of Family Medicine
"Professional Autoimmune Disorder and the State of the Social Contract"

2022 Nigel Nicholson, PhD
Walter Mintz Professor of Greek, Latin and Mediterranean Studies at Reed College, Portland, OR.
"Thinking of Yourself as a Doctor"

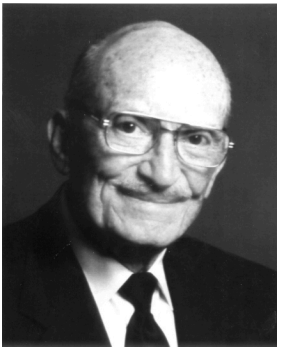
Prolo Lecturer - 2023

Kelley M. Skeff, MD, PhD, MACP

Dr. Skeff is the George DeForest Barnett Professor in the Department of Internal Medicine at Stanford University, and Co-Director of the Stanford Faculty Development Center for Medical Teachers (SFDC).

Dr. Skeff was the internal medicine residency program director at Stanford for two decades. He received his MD from the University of Colorado and his PhD from the Stanford School of Education. Dr. Skeff's academic career has focused on methods to assist faculty and residents internationally to improve their teaching effectiveness, resulting in the development of the Stanford Faculty Development Center (SFDC). The SFDC has used a dissemination approach to train faculty from institutions internationally to train their own faculty colleagues and housestaff to become more effective teachers. Since 1986, the SFDC has trained 395 faculty trainers from 156 institutions in 19 countries to become local, regional, and national resources for the improvement of medical education. These faculty have, in turn, assisted over 30,000 faculty and residents to improve their teaching effectiveness. He and colleagues have now developed an online version of the teaching improvement course.

He has received several awards including the Stanford-wide Gores Award for Outstanding Teaching Contributions, AAMC/AOA Glaser Distinguished Teacher Award in the Clinical Sciences, the first national award for Career Achievement in Medical Education from the Society of General Internal Medicine, the Association of Program Directors in Internal Medicine's Distinguished Medical Educator Award, the AAMC Flexner Award for Distinguished Service to Medical Education, and alumni awards from the Stanford School of Medicine and the Stanford Graduate School of Education. He has served as an ACP Regent, the Macy Scholars Advisory Board, and is a Master of the American College of Physicians. His most recent research work relates to the qualitative study of the challenges of physician and administrator distress leading to professional burnout, providing new insight into that current challenge.



Dr. Ralph B. Cloward 1908-2000

In 2002, the Western Neurosurgical Society established a Medal and Lecture to honor one of its most innovative and pioneering members, Ralph Bingham Cloward. With the gracious support of the Cloward family, this award honors Ralph and his devoted wife Florence, our former president and first lady, both treasured friends who have enriched the Western.

Ralph Cloward was born in Salt Lake City, Utah in 1908. He completed his undergraduate studies at the Universities of Hawaii and Utah, and his medical education subsequently at the University of Utah and Rush Medical School in Chicago. He interned at St. Luke's Hospital, Chicago, and then trained to become a neurosurgeon under Professor Percival Bailey at the University of Chicago. He began practicing neurology and neurosurgery in the Territory of Hawaii in 1938.

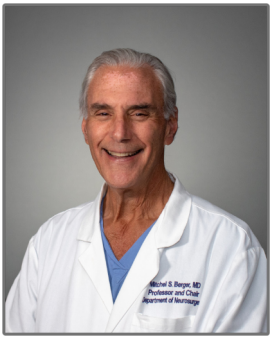
His academic accomplishments include Professor and Chair of Neurosurgery at the University of Chicago, 1954-55, and visiting professorships at the University of Oregon, University of Southern California, and Rush Medical School. He served long-term as Professor of Neurosurgery at the John A. Burns School of Medicine at the University of Hawaii. He authored numerous papers and book chapters.

Dr. Cloward's inspired, pioneering quantum leaps encompassed many areas of neurosurgery, but his enduring interest was the spine, where he devised three major operations. He first performed the posterior lumbar interbody fusion in 1943, reporting the operation at a meeting of the Hawaiian Territorial Medical Association in 1945 and publishing it in the Journal of Neurosurgery in 1953. His unique approach for treating hyperhydrosis was reported in 1957. Independently he conceived an anterior approach to the cervical spine, devised instruments for its implementation, and published his classic paper in the Journal of Neurosurgery on anterior cervical discectomy and fusion in 1958. He designed over 100 surgical instruments, which continue to be used today by practicing neurosurgeons.

Throughout his career he educated the international community of neurosurgeons in the operations he devised. He performed them throughout the United States and in 41 cities within 27 countries of the world and in the process healed patients of their painful conditions. Hundreds of thousands of patients benefited both directly and indirectly from his creativity, technical genius, insight and enthusiasm as a teacher and medical evangelist.

In first recognizing all lesions of the spine to be in the province of neurosurgeons, Dr. Cloward engendered controversy and endured severe criticism from upsetting the environment of establishment neurosurgeons by his pioneering breakthroughs. He demonstrated that even in a complex technological world with large research efforts, budgets, and bureaucracies, the individual is key. Engraved on the Medal are words the Cloward legacy epitomizes, which honors recipients "For Epochal Innovation and Pioneering Application."

2023 Cloward Award Recipient



Mitchel S. Berger, M.D.

Mitchel S. Berger M.D., F.A.C.S., F.A.A.N.S. is the Berthold and Belle N. Guggenhime Professor of the Department of Neurological Surgery at the University of California, San Francisco (UCSF). He also serves as Director of UCSF's Brain Tumor Center.

Dr. Berger is a pioneer of intraoperative brain mapping — a technique used to avoid functional areas of the brain during surgical resection of a tumor. His work has enabled surgeons to perform more extensive resection of tumor with less chance of producing sensorimotor or language deficit.

Dr. Berger is a leader of translational research and is the Principal Investigator of the UCSF Brain Tumor Research Center's Specialized Program of Research Excellence in neuro-oncology, funded by the National Cancer Institute. His specific research interests lie in identifying molecular markers related to the progression and prognosis of glial tumors, as well as the development of small-molecule therapeutic agents that can be administered directly to the brain via convection-enhanced drug delivery.

During his distinguished career, Dr. Berger has served as President of the American Association of Neurological Surgeons (AANS), President of the Society of Neuro-Oncology, and President of the American Academy of Neurological Surgery. He has also been a director of the American Board of Neurological Surgery; a member of the Board of Directors of the American Association of Neurological Surgeons; and a member of the Blue Ribbon Panel for the National Cancer Moonshot Initiative.

Prior Cloward Award Recipients

2003 George Ojemann, MD, Professor of Neurosurgery University of Washington. "Investigating Human Cognition during Epilepsy Surgery"

2005 Donald Prolo, MD, Clinical Professor of Neurosurgery Stanford University. *"Legacy Giants in the Treatment of Spinal Disorders: Ralph Cloward and Marshall Urist"*

2006 Martin Weiss, MD, Professor of Neurosurgery University of Southern California. *"A Historical Walk through Pituitary Surgery"*

2007 Charles Wilson, MD, Past Chairman, Department of Neurosurgery University of California, San Francisco. *"The Future of Neuroscience*

2008 Peter Jannetta, MD, Past Professor and Chairman Department of Neurosurgery, University of Pittsburgh. *"Vascular Compression in the Brainstem: Main Streaming Neurosurgery"*

2009 L. Nelson Hopkins, MD, Professor and Chairman of Neurosurgery University at Buffalo, State University of New York. *"Neurosurgeons and Stroke: From Prevention to Treatment"*

2010 Sean Mullan, MD, Professor Emeritus of Neurosurgery University of Chicago. *"Some Neurosurgical Fossils"*

2011 John A. Jane, Sr., MD, PhD, Professor of Neurosurgery University of Virginia Health System. *"Anterior vs Posterior Approaches to the Cervical Spine"*

2012 John R. Adler, Jr., MD Professor of Neurosurgery. Stanford University**.** *"Stepping- Out of the OR: A Surgeon's Foray into Entrepreneurship"*

2014 Andres M. Lozeno, MD, Professor of Neurosurgery, University of Toronto. *"Taming Dysfunctional Brain Circuits"*

2015 Edward Oldfield, MD, Professor Neurosurgery, University of Virginia. *"The origin of concepts in neurosurgery: One neurosurgeon's perspective"*

2016 Donald P. Becker, MD *"Brain Trauma and Beyond: A Career in Neurosurgery"*

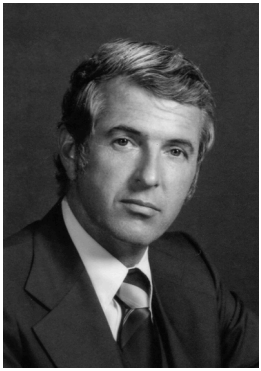
2017 Volker K.H. Sonntag, MD *"The Journey of Spinal Neurosurgery in the United States"*

2018 Edward R. Laws, Jr., MD, FACS Professor of Neurosurgery, Harvard Medical School Hospital *"Virtuosity in Surgery and Neurosurgery"*

2019 Robert F. Spetzler, MD *"My Journey in Neurosurgery"*

2021 Richard Ellenbogen, MD. *"The Myth of Equipoise"*

2022 Gary K Steinberg, MD, PhD. *"A Life Odyssey to Understand and Treat Cerebrovascular Disease, with a Few Detours"*



Randy Smith Lectureship

Randall W. Smith, Randy to all of us, was our organization's most influential and effective leader for over a generation. He was the mainstay of the Executive Committee.

Randy served the Western Neurosurgical Society in every possible capacity. In particular, he played three important roles. After serving as Secretary/Treasurer for three years, he left a“how-to” manual with a detailed timeline for duties and responsibilities. As Historian, he digitized our annual booklet programs and photos from the past, much to the enjoyment of members at our formal banquet. He started the tradition of publishing a newsletter so members and their families could anticipate the activities of the next annual meeting.

Randy was a Renaissance man. His interests were varied and extended beyond neurosurgery, though his commitment to organized neurosurgery was unwavering. He enjoyed classical music, and sports of all kinds – he had a fantastic memory of various critical plays in baseball and football, farming/ ranching –enjoyed his beloved (and producing!) avocado ranch, woodworking – leaving examples of perfection and beauty; philanthropy, reading and writing. He relished having a drink with members after a board meeting and before a reception. He was a friend and a mentor to his colleagues at the “Western” and beyond. He was very inquisitive and taught by example. He encouraged us to lead a balanced life.

He was the “Conscience” of the Western Neurosurgical Society and will be greatly missed by all.

Randy was also a mentor to many of us. He loved the Western and, in so many ways, enhanced the experience we all enjoy at our annual meetings.

On October 25, 2021, we mourned Randy's passing.

To honor his memory, the Executive Committee established the Randy Smith Lectureship.

The committee envisions annual lectures given by speakers who reflect Randy's vision of a wide range of interests in medicine and the humanities, such as music, philanthropy, hobbies, extracurricular activities, leading a balanced life, leadership, and mentorship. The Awards Committee will select speakers and presentations for the annual meetings.

We ask all WNS members to donate generously to the Randy Smith lectureship; we believe each member will enjoy the lectures, and the WNS as a whole would benefit from the lectureship.

We have raised over $50,000 so far but we need your help to reach our goal of $100,000.

If you would like to make a donation please fill in the information below, tear it out of the booklet and return to the registration desk or directly to WNS Secretary-Treasurer, Justin Dye.

Name of Donor:_____

Address:_____
City State Zip

Donation Amount:_____ Check [ ] Credit Card [ ]

Thank you in advance for your donation!

The Western Neurosurgical Society is a 501(c)(3) not for profit organization and all donors will receive a tax exempt donation receipt for tax purposes.

Please make your checks payable to the Western Neurosurgical Society. In the memo line, please write Randy Smith Lectureship.

If you prefer to mail your check, please send to:

Justin Dye MD, Secretary/Treasurer
The Western Neurosurgical Society
1533 Pamela Crest
Redlands, CA 92373

2023 Randy Smith Lecturer

Katie O'Meara Orrico, Esq.

Katie O. Orrico, Esq., is the Senior Vice President, Health Policy and Advocacy, for the American Association of Neurological Surgeons (AANS) and Congress of Neurological Surgeons (CNS) and has represented organized neurosurgery before the U.S. Congress and federal agencies since 1985. A native Washingtonian, she received her Bachelor of Arts degree in sociology, with honors, from The Catholic University of America in 1985. Upon graduation, she worked as a legislative assistant for CLP Associates, a small health care policy and advocacy firm, where she represented the AANS and CNS, among other health care clients. While working for CLP Associates, Ms. Orrico pursued her law degree at night and, in 1991, earned her Juris Doctor degree from the Antonin Scalia Law School at George Mason University. In 1997, she became the director of the AANS/CNS Washington Office, upon the establishment of a full-time office. Ms. Orrico was promoted to her current role in July 2021. She is licensed to practice law in the Commonwealth of Virginia.

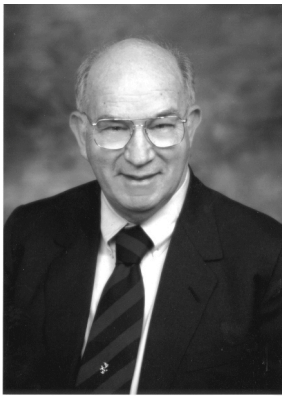
In her capacity as the AANS/CNS Washington Representative, Ms. Orrico works closely with other medical societies on several legislative coalitions, serving in a leadership role in the Alliance of Specialty Medicine, Health Coalition on Liability and Access, Partnership to Improve Patient Care, Regulatory Relief Coalition, Surgical Care Coalition, and several workgroups established by the American Medical Association (AMA). In 2022, Ms. Orrico was selected to serve as a public member of the Accreditation Council on Graduate Medical Education Review Committee for Neurological Surgery. She recently concluded service as a public member on the American Board of Medical Specialties board of directors.

In recognition of her contributions, Ms. Orrico has received several awards, including the CNS Distinguished Service Award, AANS Distinguished Service Award, AMA Medical Executive Lifetime Achievement Award, AANS/CNS Council of State Neurosurgical Societies Leibrock Lifetime Achievement Award and the California Association of Neurological Surgeons George Ablin, MD Award for Distinguished Public Service. She is also an honorary member of the American Society of Pediatric Neurosurgeons.

Ms. Orrico is a member of several professional organizations, including the American Health Lawyers Association, American Society of Medical Association Counsel, Women in Government Relations, Women in Health Policy and the Virginia Bar Association.

Katie considered Randy a mentor and friend. She is deferring honorarium to further support the Randy Smith Lectureship fund.

George Ablin



1923-1999

In 2000, the members of the Western Neurosurgical Society inaugurated a new lectureship designed to honor, in a tangible and enduring manner, one of the Society's most outstanding members. In its long history, the Society has had no more devoted contributor than Dr. George Ablin. He brought to the group stunning ability and experience, especially in matters of local, national, and international organization, in which he had few peers.

He contributed through service in many areas including a memorable term as President. He was a wise and thoughtful counselor whose advice concerning many professional and personal questions always included a careful analysis, given with words of encouragement.

There was no more active and engaged participant in all of the Society's affairs.

George Ablin was raised in Chicago, received his BS and MD from the University of Michigan, interned at Charity Hospital, New Orleans, Louisiana, did his residency at the University of Wisconsin, later was Instructor at the University of Michigan, and also became a Clinical Professor at California State University, Bakersfield. Dr Ablin was Board Certified in Neurological Surgery, a Fellow of the American College of Surgeons, and a Diplomat of the National Board of Medical Examiners.

Dr Ablin began practice in neurosurgery in Bakersfield, California, in 1953, was President of the Kern County Medical Society in 1984, and was very active in the California Medical Association in various leadership positions. He was Treasurer of the California Medical Review Board and received Distinguished Service awards from the Congress of Neurological Surgeons and the American Association of Neurological Surgeons. He was named Honorary President of the World Neurological Society and in 1989 he was selected as the Kern County Physician of the Year. George was the devoted father of seven children, three of whom became physicians.

George combined an exceptionally perceptive understanding of others, including hundreds of fellow neurosurgeons, with warmth and gentleness and lively humor. He loved his colleagues and friends, and he loved this Society. With this permanent lectureship, the members of the Western Neurosurgical Society honor George Ablin and his cherished wife, Millie.

The Randy Smith Lectureship will replace the Ablin Lecture Series.
This was respectfully discussed with and agreed upon by the Ablin family.

Prior Ablin Lectures

2000 Arthur L. Day, MD, Professor of Neurosurgery, University of Florida. *"Unruptured Intracranial Aneurysms and Sports Medicine in Neurosurgery"*

2002 Tom Campbell, JD, PhD, Professor of Law, Stanford University. Former Congressman. *"Is Freedom Possible in Medicine"*

2003 Frederic H. Chaffee, PhD, Director, WM Keck Observatory, Hawaii. *"The WM Keck Observatory at the Dawn of the New Millennium"*

2004 Gerald Kooyman, PhD, Research Professor, Scripps Institute of Oceanography, San Diego. *"Emperor Penguins: Life at the Limits"*

2005 Lt. Col. Rocco Armonda, MD, Neurological Surgeon, U.S. Army Bethesda, Maryland. *"The Modern Management of Combat Neurotrauma Injuries: Battlefield to the Medical Center"*

2006 August Turak, Spiritual and Business Consultant. *"Spirituality and the Neurosurgeon"*

2007 Donald Trunkey, MD, Internationally Renowned Trauma Surgeon. *"The Crisis in Surgery with Particular Emphasis on Trauma"*

2008 Michael Bliss, PhD, Emeritus Professor, University of Toronto. *"Working Too Hard and Achieving Too Much? The Cost of Being Harvey Cushing"*

2009 Michael A. DeGeorgia, MD, Professor of Neurology. Case Western Reserve University, Cleveland, Ohio. *"Struck Down: The Collision of Stroke and World History"*

2010 Chris Wood, PhD, Vice President for Administration, Santa Fe Institute. *"What Kind of Computer Is The Brain?"*

2011 Volker Sonntag, MD, Vice Chairman, Division of Neurological Surgery Barrow Neurological Institute, Phoenix, Arizona. *"Cervical Instrumentation: Past, Present & Future"*

2012 Robert Schrier, MD, Professor of Medicine, University of Colorado. *"Illnesses in the US Presidents in the 20th Century: Potential Impact on History"*

2013 Samuel Eric Wilson, MD, Professor, Department of Surgery, University of California, Irvine. *"Between Scylla and Charybdis: Can Academic Surgery Survive?"*

2014 Jon H. Robertson, MD, Professor of Neurosurgery, University of Tennessee. *"The challenge of the Future Neurosurgical Education"*

2015 David Piepgras, MD, Professor of Neurosurgery, Mayo Clinic. *"Frontier Surgery: Lessons for Today from Beaumont and St. Martin"*

2016 Larry R. Squire, Ph.D. Professor of Psychiatry, Neurosciences & Psychology, UCSD. **"***The Legacy of Patient H.M. – Cognitive Neuroscience of Human Memory"*

2017 Lucy Kalanithi, MD, FACP Assistant Clinical Professor, Stanford University. *"When Breath Becomes Air-A Conversation with Lucy Kalanithi"*

2018 Michael Edwards, MD, Professor of Neurosurgery, Stanford "*40 years of Pediatric Neurosurgery: The impact of Moore's Law"*

2019 Regis Haid, MD, Professor of Neurosurgery, Emory University, Atlanta, GA *"Spinal Alignment: Keys to the Kingdom"*

Local Interest Lecturer

Patrick Webster
Undersea Specialist

Patrick Webster is a marine media monkey politely pushing pixels as an underwater photographer and marine science communicator based out of Monterey Bay, California.

Raised in the foothills of the French Alps and on the outskirts of Stockholm, Sweden, Patrick fell in love with the ocean from a visit to the Monterey Bay Aquarium when he was five years old. Awestruck by the rescued sea otters diving and blowing bubbles just behind the glass, he knew that whatever *this* is, *that* is what he was going to do - and so began his quest to become some form of marine mammal himself.

After successfully sliming his way through marine biology and scientific diving classes as a UC Santa Cruz SCUBA Slug, Patrick has spent the last decade combining subtidal storytelling and his word assoseaoocean syndrome to entertain and educate about the wonders of our water world - with the kelp cathedral and its tasteful nudibranchs as his muse.

Patrick's passion to see the sea shared from the seashore has now grown into an award-winning science communication career at Monterey Bay Aquarium and as "@underwaterpat" online, with creations featured by National Geographic, The Nature Conservancy, The New York Times, BBC, TEDx and more.

Most recently he has been traveling with Lindblad/National Geographic ships to Alaska, Baja, Patagonia, Iceland and now Greenland to dive and document in colder climes. Patrick hopes that his work can joyfully bring his fellow "Earthlings" closer to the wonders of the Inner Space of Planet Ocean, to help inspire conservation of our pale blue dot on its storied journey around the sunfish.

2023 Scientific Program

Portola Hotel & Spa at Monterey Bay
Monterey, California
September 29th - October 2nd, 2023

Saturday, September 30, 2023

6:15am - 7:15am **Breakfast with Exhibitors**

7:15am - 7:20am Presidential Welcome (Jay Morgan, MD)
7:20am - 7:30am CNS Update (Alex Khalessi, MD)
7:30am - 8:15am Inaugural Randy Smith Lecture: Katie O. Orrico, Esq.
(Introduction by Jay Morgan, MD)

8:15am – 9:15am Scientific Session I
Moderators: Jay Morgan, MD and Adair Prall, MD

- 10 min talks 2 min discussion

Abhineet Chowdhary, MD	SALLY 2-year Results: Prospective trial of sacroiliac joint fusion using 3-D printed triangular titanium implants: 24 month follow up.
Namath Hussain, MD	Utilization of Dual Expandable Cages in Lateral Lumbar Interbody Fusion Surgery
Jared Ament, MD, MPH	Prospective, Randomized Study of Lumbar Facet Replacement vs Lumbar TLIF Fusion for Spondylolisthesis – Two Year Outcomes
Bruce McCormack, MD	Long-term assessments of posterior tissue-sparing fusion with facet stabilization to revise cervical pseudarthrosis
Ray Chu, MD	Orbitotomy with the Bone Scalpel

9:15am - 9:45am **Coffee with Exhibitors**

9:45am - 10:45am Scientific Session II
Moderators: Rick Chua, MD and Charlie Nussbaum, MD

- 10 min talks 2 min discussion

William Loudon, MD, PhD	Safety Evaluation of the motion of the untethered micro-robot traversing large animal cortex
James Ausman, MD, PhD	Supporting Neurosurgical Education in LMIC
Barbara Lazio, MD	The Social Distributorship: a novel approach to supplying medical instrumentation to patients in Bolivia
Anthony DiGiorgio, DO, MHA	Performance of Neurosurgeons Providing Safety-Net Care Under Medicare's Merit-Based Incentive Payment System
Thomas Scully, MD	Apoptosis of Private Practice: One Neurosurgeon's Perspective

Saturday, September 30, 2023 (continued)

10:45am - 11:30am Local Interest Lecture: Patrick Webster
(Introduction by Jason Hauptman, MD, PhD)

11:30 - 12:00pm Neurosurgeons as Innovators: Sam Browd, MD
(Introduction by Jason Hauptman, MD, PhD)

12:00pm **Adjourn for the day**

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Sunday, October 1, 2023

6:00am - 7:40am WNS Members Business Meeting (Members only)

6:30am - 7:45am **Breakfast with Exhibitors** (Non-members)

7:45am - 9:00am Scientific Session III

Moderators: Marvin Bergsneider, MD and Justin Dye, MD

- 10 min talks 2 min discussion

Rima Rindler, MD	Predicting Vasospasm and Early Mortality in Severe TBI: A Model Using Serum Cytokines, Neuronal Proteins, and Clinical Data
	Agonizing PD-1 to Reverse Subarachnoid Induced Vasospasm
Gary Steinberg, MD, PhD	Outcomes of 277 Brainstem Cavernous Malformation Resections, with and without use of CO2 Laser
Geoffrey Colby, MD, PhD	Novel Endovascular Technique for Pharmacological Block of Superior Cervical Ganglion Prevents Sympathetic Mediated Cerebral Vasoconstriction
Michael Lim, MD	Agonizing PD-1 to Reverse Subarachnoid Induced Vasospasm
Jeremiah Johnson, MD	Indications and Feasibility of Cerebral Angiography in Alternative Body Positions: A Case Series
Jeff Steinberg, MD	3-year analysis of treated intracranial aneurysms based on size and rupture status

9:00am - 9:45am Prolo Lecture: Kelley Skeff, MD, PhD
(Introduction by Don Prolo, MD)

9:45am - 10:15am **Coffee with Exhibitors**

10:15am - 11:00am Cloward Award Lecture: Mitch Berger, MD
(Introduction by Jay Morgan, MD)

Sunday, October 1, 2023 (continued)

Mini Symposium
Diversity and Inclusion in Neurosurgery:
The importance of mentorship

11:00am - 11:20am My Journey (Linda Liau, MD, PhD)
11:20am - 11:40am My Journey (Estrada Bernard, MD)

11:40am - 12:25pm **Presidential Address**: Jay Morgan, MD
"The Cornet and the Scalpel"
(Introduction by Dante Vacca, MD)

12:25 pm **Adjourn for the day**

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Monday, October 2, 2023

7:00am - 8:30am **Breakfast with Exhibitors**

8:30am - 9:00am Resident Award Presentation
(Introductions by Jason Hauptman, MD, PhD)

Basic Science Jacob Young, MD UCSF	Systemic neutralization of IL6 sensitizes IDH-wildtype glioblastoma preclinical models to immune checkpoint inhibition
Clinical Research Gianna Fote, MD, PhD UCI	Non-invasive intracranial pressure monitoring demonstrates treatment-responsive alterations in cerebral compliance in idiopathic Normal Pressure Hydrocephalus

9:00am - 10:15am Scientific Session IV

Moderators: David Westra, MD and Frank Hsu, MD, PhD

- 10 min talks 2 min discussion

Jacob Ruzevick, MD	Subperineural dissection for preservation of the facial nerve during resection of vestibular schwannoma: technique and outcomes in 145 patients
Charles Cobbs, MD	Search for novel immunotherapy targets in glioblastoma due to alternative splicing of tumor mRNA
Giyarpuram Prashant, MD	Surgical Experience in Endoscopic Endonasal Resection of Craniopharyngioma in 66 Patients
Michael Karsy, MD, PhD, MSc	Impact of Frailty on Outcomes in Patients with Cushing's Disease: Findings from the Multicenter RAPID Registry
Marvin Bergsneider, MD	Custom Flexible MRI Receiving Coil Enables Ultrahigh Resolution Imaging of the Pituitary Gland
Rudolph Schrot, MD, MAS	Treatment of Cauda Equina Symptoms from Perineurial Cysts: Examination of an Extrinsic Wrapping Surgical Approach

Monday, October 2, 2023 (continued)

10:15am - 10:45am **Coffee with Exhibitors**

10:45am - 12:00pm Scientific Session V
Moderator: Estrada Bernard, MD

- 10 min talks 2 min discussion

Brian Hanak, MD	Mastoiditis Related Epidural Abscesses Evacuation Through a Transmastoid Approach: A Case Series
Brian Lee, MD, PhD	Engineering Artificial Sensation for a Closed-loop Motor / Sensory Brain-Computer Interface
David Gonda, MD	Robotic Endoscopic Third Ventriculostomy: A Pediatric Retrospective Cohort Study of Operative Time
Laura Prolo, MD, PhD	Disparities in communication patterns among Spanish-speaking patients with hydrocephalus.
Andrew Ko, MD	Responsive neurostimulation of the pulvinar for medication refractory epilepsy: a case series
Daniel Nagasawa, MD	Congenital lumbar epidermoid cyst with associated ossification

The iconic Bixby Bridge was built with prison labor.
Anyone driving Highway 1 south to Big Sur will eventually cross the iconic landmark known as Bixby Bridge. More than 250 feet tall, it's one of the world's highest single-span concrete arch bridges.
In order to fill labor needs for the difficult project, convicts from San Quentin State Prison worked on the bridge. (It's even said John Steinbeck helped with construction. What didn't that man do?)

Monday, October 2, 2023 (continued)

12:00pm - 12:40pm Scientific Session VI - Resident Lightning Round
Moderator: Jason Hauptman, MD, PhD

- 5 min per talk

John Yue, MD	Association of Repetitive Traumatic Brain Injury with Longitudinal Recovery at 1 Year and 3-7 Years Post-Injury
Diana Chang, MD, MS, MA	Seizure Etiology on the Long-Term Outcome of Hemispherectomy
Ryan Jamiolkowski, MD, PhD	A Novel Focus of Seizure Recurrence after Temporal Lobe Epilepsy Surgery: the Fasciola Cinereum of the Hippocampal Tail
Spencer Twitchell, MD	Establishing a Benchmark for Iatrogenic Hemodilution and Blood Transfusion in Long-Segment Spine Fusion Surgery
Timothy Yee, MD	3-Level ACDF vs. 3-Level Laminectomy and Fusion: Are There Differences in Outcomes? An Analysis of the QOD CSM Cohort
Shivani Baisiwala, MD	Functional Magnetic Resonance Imaging Based Language Center Localization Protocol Identifies Language Centers and Results in Clinical Outcomes Similar to Awake Intraoperative Testing
Jeremy Guinn, MD	"Idiopathic" Subdural Hematomas and the Importance of a Detailed Patient History; a Case Series and Review of the Literature
Rajeev Sen, MD	Bypasses to Treat Complex Intracranial Aneurysms: Present Indications, Techniques, and Long-term Results

12:40pm - 12:45pm **Closing Remarks. Meeting Adjourns.**

See you next year
September 5-8, 2024

Fairmont Grand Del Mar
San Diego, CA

Scientific Session
Day I, Session I

SALLY 2-year Results: Prospective trial of sacroiliac joint fusion using 3-D printed triangular titanium implants: 24 month follow up.

Abhineet Chowdhary MD FAANS, The Core Insitute

Authorship: On behalf of the Sally Investigators

Background. Strong evidence supports minimally invasive sacroiliac joint (SIJ) fusion using triangular titanium implants (TTI) for chronic SIJ dysfunction.

Objective. To report safety and effectiveness of SIJF using a 3D-printed TTI at 24 months.

Methods. SIJF with TTI was performed in 51 subjects. Structured follow-up occurred at 3, 6, 12 and 24 months. Both quality of life questionnaires and functional tests were performed at all study visits.

Results. 84% of subjects were available for 24-month follow-up. Observed were rapid and persistent improvements in dysfunction due to pain (Oswestry Disability Index [ODI], mean 52.8 at baseline and 28.3 at 24 months, $p<.0001$) and SIJ pain ratings (mean 79 at baseline [0-100 scale] to 22 at 24 months). Opioid use for SIJ pain decreased markedly from baseline. Physical function tests impaired by SIJ pain showed persistent improvements compared to baseline. There was no evidence of device breakage, migration or subsidence and few late adverse events occurred attributable to the device. 5-year follow-up is pending. Available 5-year CT scans show device stability, osseointegration and progressive fusion of the joint.

Conclusions. In this prospective study, SIJF using 3D-printed TTI resulted in immediate, marked and persistent improvements in pain and quality of life, with improved physical function, reduced opioid use and a low rate of late device-related adverse events.

Utilization of Dual Expandable Cages in Lateral Lumbar Interbody Fusion Surgery

Namath Hussain, MD**,** Loma Linda University

Emmanuel Omosor, Brandon Edelbach, Hammad Amer
Loma Linda University

Introduction: The aim of this study is to present a case series of adult patients with lumbar degenerative scoliosis who underwent focused MIS utilizing a new expandable cage technology. The study investigates the effectiveness of this approach in reducing the symptoms and progression of lumbar degenerative scoliosis (LDS).

Methods*:* Adult patients with lumbar degenerative scoliosis were selected for focused MIS using the newly introduced expandable cage technology. Patient demographics, preoperative evaluations, surgical details, and postoperative outcomes were recorded. The primary outcome measures included the restoration of disc space height, improvement in clinical outcomes, and reduction in surgical complications.

Results*:* Preliminary analysis of the case series reveals promising outcomes following focused MIS with the utilization of the new expandable cage technology. The technique demonstrated successful restoration of intervertebral disc space heights and improved clinical outcomes in patients with lumbar degenerative scoliosis. Furthermore, a notable reduction in surgical complications was observed.

Conclusion*:* The findings from this case series suggest that focused MIS with the implementation of the new expandable cage technology holds promise for patients with lumbar degenerative scoliosis. This approach appears to effectively restore disc space heights, improve clinical outcomes, and minimize surgical complications. Here we want to emphasize the improved clinical outcomes; however, further research and larger prospective studies are warranted to validate these preliminary results and establish the long-term benefits and safety profile of this innovative technique.

Prospective, Randomized Study of Lumbar Facet Replacement vs Lumbar TLIF Fusion for Spondylolisthesis - Two Year Outcomes

Jared Ament, MD, MPH, FAANS, Neurosurgery & Spine Group, Cedars Sinai Medical Center

Introduction: The surgical treatment for lumbar spondylolisthesis has remained somewhat controversial. Posterior lumbar arthroplasty with facet replacement is a novel alternative to lumbar decompression and fusion. There are currently no FDA-approved devices for facet replacement. The TOPS System is a robust, pedicle screw-based biomechanical device intended to replace the facets and posterior elements following aggressive decompression.

Background: Lumbar facet replacement is a novel motion-preserving procedure that can be used to treat spondylolisthesis with stenosis. There is an ongoing multicenter, prospective, randomized, controlled US Food and Drug Administration (FDA) Investigation Device Exemption (IDE) trial evaluating the clinical and radiographic outcomes of an investigational facet replacement device versus lumbar fusion with interbody fusion with pedicle screw fixation for the treatment of Grade I degenerative spondylolisthesis and stenosis.

Methods: This interim analysis included 299 subjects randomized 2:1 to artificial facet replacement versus TLIF using a monolithic PEEK interbody spacer and pedicle screw fixation. The primary endpoint was composite clinical success (CCS) at 24 months defined as a ≥15-point improvement in the Oswestry Disability Index from baseline, and no surgical reintervention that involved revision, removal, or supplemental fixation, and no new or worsening neurological deficit, and no implant failure. Secondary endpoints included Visual Analog Scale (VAS) back and leg scores, Zurich Claudication Questionnaire (ZCQ) scores and all cause reoperation rates.

Results: At the time of this analysis 299 subjects have been enrolled (TOPS =206; TLIF= 93) and a total of 140 subjects were assessed for the primary endpoint of 24 month CCS (TOPS=109, TLIF=46). Among the facet replacement group 84.4% (N=92/109) of subjects achieved composite clinical success compared to 67.4% (N=31/46) of TLIF subjects. The mean (95% CI) group difference was 17% (1.8%, 32.2%) which is statistically significant (p=0.0283). Among the secondary endpoints, the facet replacement group reported significantly greater improvement in VAS backpain with an improvement from baseline to 24 months of 54.6 $\pm$ 31.2 compared to an improvement of 37.1 $\pm$ 32.4 for the fusion group, a mean (95% CI) group difference of 17.5 (29.9, 5.0). A significant improvement in VAS leg pain was reported for both groups with facet replacement subjects reporting an improvement of 69.6 $\pm$ 28 compared to an improvement of 60.7 $\pm$ 33.3 for the fusion group, a mean (95% CI) group difference of 8.9 (20.5, -2.7). The facet replacement group reported significantly better scores at 24 months in all components of the ZCQ ($P<0.05$). Reoperation rates were similar for both the facet replacement group (5.3%) and the fusion group (8.6%).

Conclusion: Early results demonstrate that facet replacement may offer significantly better outcomes compared to TLIF at 24 months of follow-up. Continued long-term follow-up is required to validate early findings and evaluate differences between facet replacement and fusion.

Long-term assessments of posterior tissue-sparing fusion with facet stabilization to revise cervical pseudarthrosis

Bruce McCormack, MD, University of California San Francisco

Michael Haglund, MD, PhD, Duke University, Daniel Williams, MD, Pinehurst Surgical, Alexander Lemons, MD, Pinehurst Surgical, Pinehurst, NC

Background Context: Posterior cervical fusion (PCF) with lateral mass screws (LMS) achieves reliably solid arthrodesis with rates exceeding 90% when performed for treatment of symptomatic pseudarthrosis following ACDF. Soft tissue dissection for PCF causes perioperative pain, wound infections, hospital re-admission, and can result in chronic myofascial pain. A tissue-sparing PCF approach involving intra-facet cages reduces the rates of post-operative complications, while adequately stabilizing the symptomatic level to achieve arthrodesis. The goal of this study was to understand long term radiographic and clinical outcomes in patients revised with tissue-sparing PCF to treat pseudarthrosis.

Methods: A surgical chart review across six sites identified 150 records of patients treated with tissue-sparing PCF to revise an ACDF pseudarthrosis. Eighty-nine patients identified in the initial chart review (59%) enrolled for prospective assessment of clinical and radiographic outcomes. The median follow-up time was 38 months (range 12-76) following their posterior fusion. A total 173 revised levels were assessed. CT and dynamic x-rays were taken to determine evidence of contiguous bridging bone at the interbody space and facet joints for each revised level. Range of motion was measured using quantitative motion analysis software. All radiographic assessments were performed by an independent core imaging laboratory.

Results: The median number of levels revised was 2 (range 1-5). Median operative duration was 45 minutes with an estimated blood loss of 10cc. Patients were discharged a median 1 day following surgery. There was one instance of re-hospitalization due to deep vein thrombosis related to complications from the patient's IV site. No cases required subsequent surgical intervention at the revised levels.

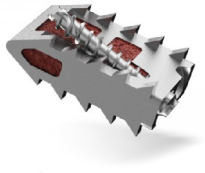
Segmental range of motion on dynamic x-ray was less than 2 degrees in 89% of assessed levels. Contiguous bridging bone was present across 83% of the assessed vertebral interbody space and 75% of the assessed bilateral facets. Bridging bone was present across both the interbody and facets in 73% of the assessed levels.

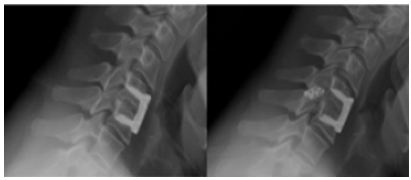
Satisfactory clinical outcomes were reported in 82% of respondents as determined by answering "very satisfied," "satisfied," or "somewhat satisfied" following revision. Subjects achieving ROM less than two degrees across all levels were more likely to report satisfactory outcomes than those with gross movement ($ROM<2^{\circ}$=88%; $ROM\geq2^{\circ}$=78%, p=0.021). Subjects with interbody bridging bone across all revised levels had numerically greater satisfaction however this was not statistically different (85% vs. 82%, p=0.260).

Conclusions: These outcomes provide evidence in support of tissue-sparing PCF with facet cages as a treatment for symptomatic pseudarthrosis after ACDF. Solid arthrodesis at the revised level was evident from minimal segmental ROM, with most patients achieving stabilization indirectly at the site of the interbody pseudarthrosis. Positive radiographic outcomes were complimented by positive clinical outcomes. Patients were satisfied with their surgery and none required subsequent surgical intervention.

Figure 1 Stabilization achieved through bilateral intrafacet cages with bone screw

Figure 2 Single level ACDF with pseudarthrosis revised using tissue-sparing PCF with facet stabilization.





Orbitotomy with the Bone Scalpel

Ray Chu MD, Cedars Sinai Department of Neurosurgery

Introduction: The technique of utilizing a bone scalpel for the orbitotomy during resection of orbital tumors is described. Using a bone scalpel can be safer than using a drill or a reciprocating saw and saved intraoperative time compared to using multiple punches. The thin cut of the bone scalpel also allows replacement of the autologous bone flap versus resection of the orbital roof and using a fat graft or piece of absorbable mesh.

Methods: This is a retrospective review of orbitotomy patients for whom the bone scalpel orbitotomy technique was performed.

Results: Five patients were included in the analysis. Pathology of the orbital tumors ranged from metastases to meningiomas. There were no complications or patient complaints related to the technique.

Conclusions: Using a bone scalpel for the orbitotomy may be able to save time and allows replacement of the native bone flap when facing intra-orbital tumors.

Scientific Session
Day I, Session II

Safety Evaluation of the motion of the untethered micro-robot traversing large animal cortex

William Loudon MD PhD[1,2], Michael Kardosh MS[3] Alex Kiselyov PhD[1], Florent Cros MS[1], , Michael Shpigelmacher MS[1]

[1]Childrens Hospital of Orange County, Orange CA, [1]University of California Irvine, Irvine CA, Bionaut Labs, Culver City,[2] CA/[3]Tel Aiv, IL[3]

Preliminary safety studies of Bionaut microrobot motion through brain tissue were performed by comparison to that of standard ventricular catheter insertion. Gross pathology, microscopic histology and animal behavior were evaluated in catheter control and Bionaut study animals at 24h, 2 weeks, 3 and 6 months post-procedure. Tissue changes and animal behavior proved very comparable, further supporting the safety of this novel neurosurgical tool.

Introduction: Contemporary techniques for deep brain access rely upon transcranial portals of entry, many of which were defined in the early to mid-1900s. Skull base, anterior brain stem and low midline structures continue to represent particularly challenging targets to access for neurosurgical procedures and local drug delivery utilizing these access vectors. Novel minimally invasive therapeutic strategies including specialized delivery systems such as convection-enhanced delivery (CED) have been proposed but continue to fall short of therapeutic goals. Safe access to many eloquent targets, allowing microsurgical procedures and/or enhanced delivery of therapeutic modalities, remains a major unmet need for many CNS pathologies. Bionaut Labs has developed a first in class modular microrobotic platform for performing localized delivery of diverse therapeutics in vivo or microsurgical procedures utilizing a completely untethered microrobot which navigates through CSF and brain tissue. Navigation is stereotactically controlled in a closed loop system, relying upon real-time 3D fluoroscopic imaging communicating with the external magnetic propulsion system. Preclinical testing for the Bionaut has included comparison of CNS tissue reaction to the motion of the Bionaut in comparison to that encountered with insertion of standard ventricular catheters along similar trajectories. A summary of these results is presented here.

Methods: Sheep: 6-8 month Assaf Sheep breed (40-50kg)

Bionaut (Screw type) Specifications:
Outer Diameter: 3.2mm
Length: 12.3mm
Ventricular Catheter Specifics
Medtronic ARES Antibiotic impregnated catheter
Outer Diameter: 2.5mm

Results: Either a ventricular catheter or a Bionaut were introduced through a burr hole at the described in Figure 1. Catheters were passed a distance of 5cm through supratentorial cortex as controls. Bionauts were navigated 4-7cm utilizing the Magnetic Propulsion System (MPS). Groups of Control and experimental animals, operated upon on the same day, were sacrificed at 24h, 2 weeks, 3months and 6 months. Gross specimen review and microscopic histopathology were independently evaluated by an outside animal pathology laboratory. Results were remarkably consistent and comparable with the lumen of the passage reflecting the outer diameter of either the catheter or Bionaut, with the periluminal pathology exhibiting virtually identical pathological characteristics consistent with the time from surgery. Images with associated data will be presented.

Conclusions: To evaluate the relative safety of Bionaut navigation through brain tissue, side by side comparison of gross pathology and microscopic histopathology from catheter control vs. Bionaut study animals were individually evaluated by two outside pathologists. Observed lumen diameters proved consistent with the out diameter of the Bionaut or catheter. Periluminal changes were equivalent and evolved as per expectations.

Summary: The Bionaut Platform represents a first in class untethered micro-robotic minimally invasive surgical and drug delivery system. Preclinical safety evaluation verifies tissue reaction to Bionaut travel is comparable to established catheter insertion. Ongoing studies are confirming the efficacy and safety of novel delivery of diverse therapeutics (small molecules, ASOs, mAb, viral vectors, cell therapies, etc.).

Figure 1: Placement of Burr Holes: 1 cm laterally from midline, 3 cm anterior to lambdoid suture.

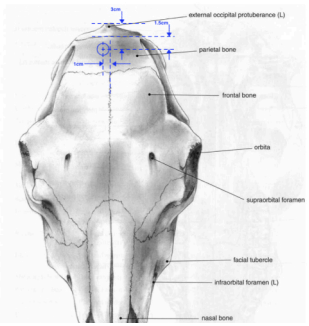
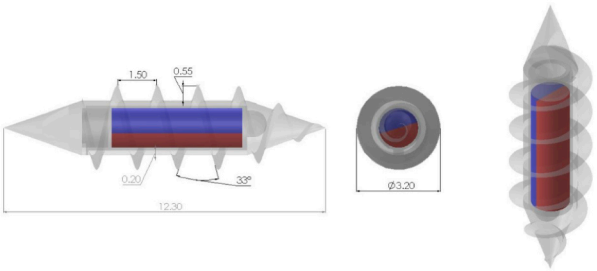


Figure 2: Bionaut specifications



Supporting Neurosurgical Education in LMIC

James I. Ausman, MD, PhD ; UCLA Department of Neurosurgery; James I. and Carolyn R. Ausman Educational Foundation; (SNI™, SNI Digital®)

Samer Hoz, MD; Jorge Lazareff, MD; A. Hadi Al Khalili, MD; Tarun Aurora, MD; Nancy Epstein, MD; Jim Cook.

Introduction: LMICs represent 85% of the world's population. Iraq, a LMIC, is recovering from wars which left its Neurosurgical Educational programs isolated and disorganized locally and internationally. Using SNI™ and SNI Digital®'s human and publishing resources, our goal was to work with local talent enhancing efforts to develop a national and international presence in neurosurgery.

Methods & Results:

1. From his clinical practice as a neurosurgeon in Iraq, Dr. Hoz had developed a microsurgical laboratory to which students were attracted and involved in clinical research, presentations, and writing papers and books on neurosurgical topics.
2. Surveys were performed by the students assessing the value of our regular Zoom meetings in addition to their other educational experiences with >90% approval. A popular lecture series on the development and analysis of data by Dr. Lazareff was given to the students. Discussion was encouraged in all formats to invite ideas and adapt the meetings to the local needs. Responses indicated these local & national meetings were "inspiring" to the students providing them "hope" and "goals for the future".
3. New monthly meetings were organized with practicing Iraqi neurosurgeons who presented their work. These meetings were attended by up to 150 people including students from Iraq and neighboring countries, 18/19 Iraq Governates, and all 22 medical schools. Subjects included the entire spectrum of neurosurgery.
4. Speakers from outside Iraq expressed a high regard for the talented Iraqi male and female neurosurgeons doing innovative top quality work to serve their patients, making use of limited resources and money.
5. This project started in June 2021. Forty seven papers & 4 videos, were published in SNI™ & SNI Digital® by 126 authors from 12 Arab countries & by 67 attending neurosurgeons, 11 residents, and 48 medical students)

Conclusions: In LMICs there is a place for outside neurosurgical educational and organizational help to encourage participation on the world stage of Medicine and Neurosurgery in the 21st century.

There are no dairy farms in the city of Monterey; the semi-hard cheese known as Monterey Jack originated in nearby Carmel Valley, and is named after businessman and land speculator David Jack.

The Social Distributorship: a novel approach to supplying medical instrumentation to patients in Bolivia

Barbara, Lazio, MD, FAANS , Oregon Health and Science University

Juan-Lorenzo Hinojosa, PhD, Solidarity Bridge, Richard Moser, MD, University of Massachusetts

Introduction: Spinal trauma is common in Bolivia but quality spinal instrumentation is difficult to access in low and middle income countries (LMIC). Neurosurgeons in LMIC have often relied on donated instrumentation from higher income countries to care for patients. Hardware supplied by local vendors is cost-prohibitive to patients who must pay out of pocket. When a patient suffers a spinal fracture in Bolivia, where the average per capita annual income is less than $4000 USD, the patient is responsible for locating and paying up-front for the hardware needed to stabilize the spine surgically. Patients must often choose between treatment with financial devastation to their family versus no treatment and risk of neurologic catastrophe. Donated instrumentation and humanitarian missions to Bolivia can help a small percentage of the injured, but donations are often made from discontinued lines, making restocking and instrument maintenance an ongoing challenge for the neurosurgical teams in Bolivia year-round.

Methods: Humanitarian organization Solidarity Bridge has developed a novel social distributorship to supply needed spinal instrumentation to Bolivian neurosurgeons and their patients year-round. They vetted several vendors to ensure they could supply quality spinal hardware at a reasonable price, then formed an independent company, Solidarity Medical Equipping (EMS). The distributorship employs two technical representatives, who bring the equipment to the surgeons and provide on-site support during surgery like a representative from a commercial company. EMS, unlike the commercial distributorships it is modeled after, is a not-for-profit organization and provides spinal instrumentation to patients on a sliding payment scale based on financial ability.

Results: Since its implementation in 2020, EMS has supplied affordable spinal instrumentation to dozens of Bolivian patients.

Conclusion: A novel social distributorship has facilitated supply of spinal instrumentation to Bolivian patients. The model has potential to supply other expensive medical supplies to patients in Bolivia and other LMIC.

Performance of Neurosurgeons Providing Safety-Net Care Under Medicare's Merit-Based Incentive Payment System

Anthony M DiGiorgio, DO, MHA, Department of Neurological Surgery, University of California, San Francisco

Philip R Lee Institute for Health Policy Studies, University of California, San Francisco, Mercatus Center at George Mason University, Washington, DC, Grace Ng, MD, MSc, Department of Neurosurgery, Massachusetts General Hospital, Harvard Medical School, Boston, MA

Background and Objectives: Under the Merit-Based Incentive Payment System (MIPS), Medicare evaluates provider performance to determine payment adjustments. Studies examining the first year of MIPS (2017) showed that safety-net providers had lower MIPS scores, but the performance of safety-net providers over time has not been studied. This study aimed to examine the performance of safety-net versus non-safety-net neurosurgeons in MIPS from 2017-2020.

Methods: Safety-net neurosurgeons were defined as being in the top quartile according to proportion of dual-eligible beneficiaries, and non-safety-net in the bottom quartile. Outcomes were total MIPS scores and dual-eligible proportion over time. In this descriptive study, we evaluated ordinary least squares regression models with standard errors clustered at the physician level. Covariates of interest included safety-net status, year, and average HCC risk score of beneficiaries.

Results: There were 2,796-3,322 physicians included each year between 2017-2020. Mean total MIPS scores were not significantly different for safety-net than non-safety-net physicians in 2017, but were greater for safety-net in 2018 (90.7 vs. 84.5, p<.01), 2019 (86.4 vs 81.5, p<.01), and 2020 (90.9 vs. 86.7, p<.01). Safety-net status (coefficient -9.11; 95% CI [-13.15, -5.07]; p<.01) and participation in MIPS as an individual (-9.89; [-12.66, -7.13]; p<.01) were associated with lower scores, while year, the interaction between safety-net status and year, and participation in MIPS as a physician group or alternative payment model were associated with higher scores. Average HCC risk score of beneficiaries (-.011; [-.015, -.006]; p<.01) was associated with decreasing dual-eligible case mix, while average age of beneficiaries (.002; [.002, .003]; p<.01) was associated with increasing dual-eligible case mix. Conclusion: Being a safety-net provider was associated with lower MIPS scores, but safety-net neurosurgeons demonstrated greater improvement in MIPS scores than non-safety-net neurosurgeons over time. Providers with higher-risk patients were more likely to decrease their dual-eligible case mix over time.

Conclusion: Being a safety-net provider was associated with lower MIPS scores, but safety-net neurosurgeons demonstrated greater improvement in MIPS scores than non-safety-net neurosurgeons over time. Providers with higher-risk patients were more likely to decrease their dual-eligible case mix over time.

Apoptosis of Private Practice: One Neurosurgeon's Perspective

Thomas Scully, MD, FAANS, TMCOne Northwest NeuroSpecialists

Introduction: There has been a significant change in employment models within medicine. Physician employment (distinct from private practice) rose from 29% in 2003 to 42% in 2012. Currently, it is estimated 69% of US physicians are employed. There are many implications related to this from a care perspective.

Methods: This paper explores one neurosurgeon's experience of 30 years in private practice, and the forces that have led to his current employed status.

Results: Data related to expenses, federal mandates, market forces and varying income and expenses will be presented.

Conclusions: The changing landscape of American healthcare results in the loss of private practice as a viable business model. The implications related to physician autonomy will be explored.

Neurosurgeons as Innovators

Samuel Browd, MD, Seattle Childrens Hospital

The worlds of neurosurgery and computational science are intersecting at the nexus of the operating room and across the continuum of patient care. As medicine moves toward digitizing all aspects of a patient's care, immense amounts of patient data generated and aggregated across surgeons, procedures, and institutions will enable previously inaccessible computationally driven insights. These early insights from artificial intelligence (AI) and machine learning (ML)-enabled technologies are beginning to transform medicine and surgery. The complex pathologies facing surgeons and their patients require integrative, multimodal, data-driven management strategies. As these data and the technological tools to computationally process them become increasingly available to neurosurgeons, AI and ML methods will inform patient selection, preoperatively risk-stratify patients based on myriad factors, and inform interoperative surgical decisions. Once these tools enter early clinical practice, their use creates a virtual flywheel whereby the use of these tools generates additional data that further accelerate the evolution of computational "knowledge" systems. At this digital crossroads, interested and motivated surgeons have an opportunity to understand these technologies, guide their application toward optimal care, and advocate for opportunities where these powerful new tools can deliver step changes in efficiency, accuracy, and intelligence. We will review the nomenclature and basics of AI and ML and highlight the current and future applications of these technologies across the care continuum of neurological surgery.

Scientific Session
Day 2, Session III

Predicting Vasospasm and Early Mortality in Severe TBI: A Model Using Serum Cytokines, Neuronal Proteins, and Clinical Data

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Introduction: It is difficult to predict outcomes in patients with severe traumatic brain injury (sTBI) using current clinical tools. The goal of this study was to develop a predictive model for post-traumatic vasospasm and mortality in sTBI patients by combining clinical data and serum inflammatory and neuronal proteins for improved prognostication.

Methods: Fifty-three adult civilian patients were prospectively enrolled in the sTBI arm of the Surgical Critical Care Initiative (SC2i). Patient clinical, serum inflammatory and neuronal protein data were combined and evaluated using the machine learning methods of LASSO and CART to construct parsimonious models for predicting development of post-traumatic vasospasm and mortality.

Results: Thirty-six (67.9%) patients developed vasospasm and 10 (18.9%) died. Mean age was 39.2; 22.6% were women. There were 25 Caucasian and African American patients, 3 from other races. For vasospasm, CART identified lower IL9, lower presentation pulse rate and higher eotaxin as predictors (full data AUC = 0.89, mean cross validated AUC = 0.47). LASSO improved upon the CART high risk model by identifying higher Rotterdam CT score (p=0.02) and lower age (p=0.01) as risk factors for vasospasm development (full data AUC 0.94, sensitivity 0.86, specificity 0.94; cross-validation AUC 0.87, sensitivity 0.79 and specificity 0.93). For mortality, CART identified higher levels of S100B and higher BUN as predictive of mortality (AUC 0.856, cross validation AUC 0.57). LASSO identified higher serum IL6 (p=0.03) and higher glucose (p=0.04) as predictive variables for mortality (full data AUC 0.893, sensitivity 0.8, specificity 0.907; cross-validation AUC 0.82, sensitivity 0.79 and specificity 0.86).

Conclusion: Inflammatory and glial-specific protein levels following sTBI may have predictive value that exceeds conventional clinical variables for certain outcomes. Eotaxin, IL9, and pulse rate predict development of post-traumatic vasospasm. BUN, S100B, IL6, IL12, and blood glucose were predictive of mortality. These results warrant validation in a prospective cohort.

Outcomes of 277 Brainstem Cavernous Malformation Resections, with and without use of CO2 Laser

Gary K. Steinberg, MD PhD, Department of Neurosurgery, Stanford University

Jason L. Choi, MD, Andrew J. Gauden, MBBS PhD, Paritosh Pandey, MD
Department of Neurosurgery, Stanford University

Introduction: Resection of brainstem cavernous malformations is challenging and poses significant risks. The objective of this study was to provide short and long-term outcomes of surgically treated brainstem cavernous malformations, and evaluate if there is a difference in outcomes using a CO2 laser.

Methods: The electronic and paper charts of all the patients who underwent resection of the brainstem cavernous malformations between 1990-2023 by a single surgeon was reviewed. Short and long-term (≥ 3 mos) follow up was assessed through chart review and telephone follow up as needed. A total of 277 brainstem cavernous malformation resections were reviewed, with regard to use of the CO2 laser, surgical approach, lesion characteristics, and patient outcomes.

Results: 277 surgeries in 254 patients were recorded, with mean follow up of 4.7 years. 126/277 surgeries were performed with the CO2 laser. 24% had immediate perioperative worsening of their neurologic status, but 82% demonstrated the same or improved mRS compared with preoperative status at their delayed postoperative follow-up. In multivariate analysis, age ≤40 yo, lower preop mRS and CO2 laser surgery were predictors of good long term outcome. The use of the CO2 laser was significantly correlated with improvement in long term follow up mRS when compared to conventional microsurgery (Laser: Pre-Op mRS 1.98, Follow-up mRS 1.73; Conventional: Pre-Op mRS 2.03, Follow-up mRS 1.98; p= 0.017).

Conclusions: The use of the CO2 laser for resecting brainstem cavernous malformations was significantly correlated with better long-term improvement in mRS when compared to conventional surgery. It should be considered for resecting cavernous malformations in brainstem, as well as other eloquent areas.

Monterey was the site of the July 7, 1846, Battle of Monterey during the Mexican-American War. It was on this date the U.S. Flag was raised over the Monterrey Custom House and California was claimed for the United States.

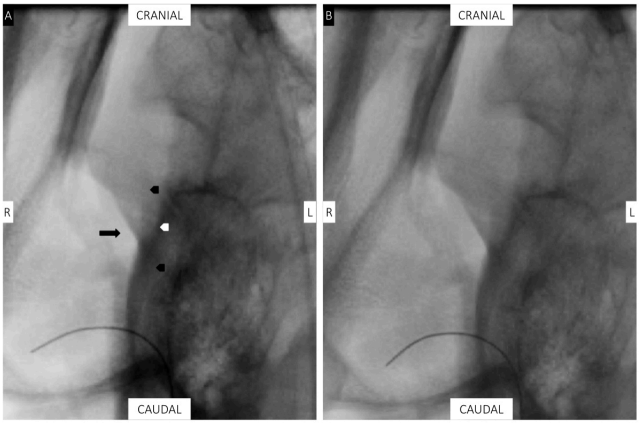
Novel Endovascular Technique for Pharmacological Block of Superior Cervical Ganglion Prevents Sympathetic Mediated Cerebral Vasoconstriction

Geoffrey P. Colby, MD, PhD, FAANS Department of Neurosurgery, UCLA

Wi Jin Kim MD Department of Neurosurgery, UCLA; Hasitha Milan Samarage MBBS Department of Neurosurgery, UCLA; Matiar Jaffari MD PhD Department of Neurosurgery, UCLA; David Zarrin MSE David Geffen School of Medicine, UCLA; Keshav Goel BS, David Geffen School of Medicine, UCLA; Xin Qi BS David Geffen School of Medicine, UCLA; Anthony Wang MD Department of Neurosurgery, UCLA; Jeremiah Johnson MD Department of Neurosurgery, UCLA

Introduction: Sympathetic mediated vasoconstriction from the superior cervical ganglion (SCG) is a significant contributor to cerebral vasospasm. Inhibition of the SCG has been shown to improve cerebral blood flow and reverse cerebral vasoconstriction in swine models. We evaluated the efficacy of a novel, minimally invasive endovascular approach to target and pharmacologically inhibit the SCG, using a Micro-Infusion Device for transmural drug delivery.

Methods: Eight SCGs in four Yorkshire swine were surgically identified. After confirming appropriate sympathetic-mediated intracranial vasoconstriction response with SCG stimulation, an endovascular Micro-Infusion Device was used for targeting and delivery of a lidocaine-contrast mixture to the perivascular space and SCG.



AP view of right neck showing positioning and transmural lidocaine injection
(A) Fluoroscopy showing Micro-Infusion Device in the right common carotid artery with injection needle targeting the SCG. Electric needle stimulators in the right SCG (black arrow). Black arrowheads = balloon markers. White arrowhead = Orientation marker for needle. (B) Fluoroscopy single shot showing immediate post injection of lidocaine/contrast solution.

Digital subtraction angiography was obtained at: 1) baseline; 2) with SCG stimulation; and 3) after lidocaine delivery to the SCG using the Micro-Infusion Device with concurrent SCG stimulation. Vessel diameters were measured and compared.

Results: Stimulation of the SCG produced significant ipsilateral vasoconstriction in the cranio-cervical vasculature. Endovascular transmural delivery of lidocaine to the SCG and carotid perivascular tissue successfully inhibited this vasoconstriction despite subsequent SCG stimulation in all eight tests.

Conclusions: We demonstrate a novel endovascular technique of transmural delivery of lidocaine to the SCG and carotid artery perivascular tissues to inhibit sympathetic mediated cerebral vasoconstriction. These results suggest promising translation to humans for clinical use in patients with cerebral vasospasm.

Agonizing PD-1 to Reverse Subarachnoid Induced Vasospasm

Michael Lim, MD Stanford

Jackson, Christopher MD, Johns Hopkins; John Choi MD, MEd, Stanford; Denis Routkevitch, Ayush Pant, Laura Saleh, Xiaobu MD, MS, Saleh, Laura Ye, Xiaobu MD, MS Justin Caplan MD, Judy Huang MD , Cameron McDougall MD, Drew Pardoll MD, PhD, Henry Brem MD, Rafael Tamargo MD, all from Johns Hopkins

Introduction: Vasospasm after aneurysmal subarachnoid hemorrhage (SAH) is a major cause of morbidity and mortality in patients. We investigated the role of peripheral monocytes in inducing vasospasm.

Methods: Using a murine SAH model, we measured the levels of circulating PD-1+ monocytes after inducing a hemorrhage. We also assessed serum samples from patients in the ICU after they presented with an aneurysmal subarachnoid hemorrhage. We then treated the mice with PD-L1 to try and prevent vasospasm.

Results: We observed a rise of PD-1+ monocytes in the periphery of both the animals and in patients that peaked a day prior to the onset of vasospasm. We were able to prevent vasospasm in our murine subarachnoid hemorrhage model with the administration of PD-L1.

Conclusion: We believe that subarachnoid induced vasospasm is mediated by PD-1 positive monocytes that migrate to the brain from the bone. Furthermore, we can potentially prevent vasospasm by treating the monocytes with PD-L1.

Indications and Feasibility of Cerebral Angiography in Alternative Body Positions: A Case Series

Jeremiah N. Johnson, MD, Department of Neurosurgery, University of California, Los Angeles

Aislyn C. DiRisio, MD, MS, Anthony C. Wang MD, Geoffrey P. Colby MD, PhD
Department of Neurosurgery, University of California, Los Angeles

Introduction: Cerebral angiography is typically undertaken in the supine position using femoral or radial access. While this is effective and sufficient in most patients, some clinical scenarios necessitate alternative positioning and considerations.

Methods: A case series was performed for cerebral angiography performed in positions other than supine. Cases were reviewed for indications for alternative positioning, arterial access, feasibility, technical considerations, and limitations.

Results: Four patients who underwent angiography in prone, lateral, or seated positions were included in our case series. Reasons for alternative patient positioning included: 1) intra-operative positioning in three patients who underwent an angiogram to assess for extent of surgical resection without pre-operative sheath placement and 2) clinical considerations including onset of symptoms in the upright positions in a patient who had previously undergone an unrevealing supine cerebral angiogram. The feasibility of the arterial access in each position and the setup required to obtain imaging from these positions were taken into account in each case. In all operative cases, access was obtained post-operatively and with the patient in the operative position. Arterial access was obtained via radial, common femoral, and ulnar arteries and imaging performed with portable C –arm fluoroscopy units. The rise of trans-radial access cerebral angiography was critical to enabling angiography in non-traditional body positions. Limitations of non-traditional positioning includes partial image obstruction by intra-operative equipment and necessity of adapting equipment designed to perform supine cerebral angiography achieve to alternative imaging positions. Despite this, goals were met in each of the angiograms performed without complications, illustrating that these techniques are feasible and safe.

Conclusion: Cerebral angiography in prone, lateral, and seated positions is feasible and may be preferred in cases in which clinical circumstances do not favor a supine cerebral angiogram. Development of angiography equipment that better facilitates imaging in alternative body positions is an opportunity for further development.

3-year analysis of treated intracranial aneurysms based on size and rupture status

Jeffrey Steinberg, MD, Neurosurgery Faculty, University of California at San Diego

Ryan Sindewald, Medical Student, University of California at San Diego
Michael Brandel, MD, Neurosurgery Resident, University of California at San Diego

Introduction: Intracranial aneurysms remain a significant pathology within the field of neurosurgery with a primary distinction being rupture status. Ruptured aneurysms are universally known to require expedited treatment, however the decision to treat unruptured aneurysms depends on various factors, including size, morphology, family history, and comorbidities.

Methods: In this study we reviewed all treated saccular aneurysms from 2020-2023 by the senior author and examined size and rupture status. We excluded dissecting, blister, and previously treated aneurysms. The Wilcoxon rank sum test was used to compare the sizes of ruptured and unruptured aneurysms.

Results: Ninety four aneurysms were treated during the time period; 11 were excluded based on the above criteria. Fifty (60%) and 33 (40%) were unruptured and ruptured, respectively. Unlike ruptured aneurysms, the size of unruptured aneurysms followed a normal distribution (Figure 1). Unruptured aneurysms measured a median of 5.8mm (interquartile range [IQR] 4.2-7mm), while ruptured aneurysms measured a median of 5mm (IQR 3.5-7mm). No statistically significant difference was found between the sizes of ruptured and unruptured aneurysms. 72.7% of the aneurysms were 4mm or less, and 78.8% were 6mm or less

Conclusions: In this retrospective single-surgeon experience, there was no difference in size of treated ruptured and unruptured aneurysms. This finding challenges the conclusions of several large prospective studies such as the ISUIA study, which used aneurysm size as the most important factor in stratifying rupture risk. Small aneurysms also carry a nontrivial rupture risk, necessitating early diagnosis, surveillance, and potential treatment. Moving forward, analysis of flow dynamics, vessel wall characteristics, and high-resolution morphology may help elucidate high risk features of unruptured aneurysms.

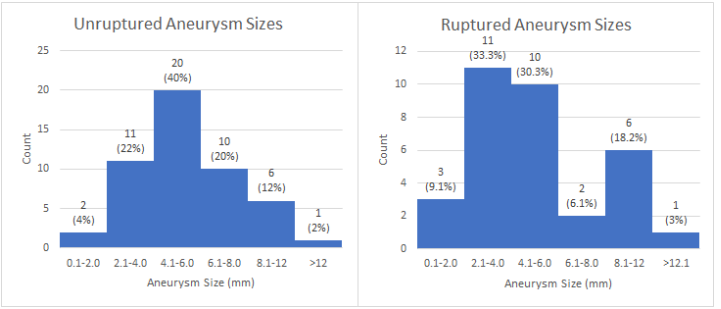


Figure 1 Size Distributions of ruptured and unruptured treated intracranial aneurysms.

2023 Basic Science Resident Award Recipient

Jacob Young, MD
University of California
San Francisco

Jacob Young, MD is a neurosurgery resident with an interest in neurosurgical oncology and immunotherapy. His translational research focuses on investigating novel viral and immunological agents for the treatment of high grade gliomas and his clinical research explores how to optimize functional outcomes and minimize complications after surgery for intrinsic brain tumors. He works closely with mentors Manish Aghi MD PhD, Shawn Hervey-Jumper MD, Hideho Okada MD PhD, David Raleigh MD PhD, and Mitchel Berger MD on projects exploring these topics.

Jacob's research accomplishments have been recognized at the institutional, regional, and national levels and his work has been funded by the NIH, NCI, and the Chan-Zuckerberg Biohub.

His clinical performance has been recognized with the Krevan's Award for Excellence in Patient Care at the Zuckerberg San Francisco General Hospital, the Howard Naffziger Award for Outstanding Clinical Service and Care to Neurosurgical Patients at UCSF, and the Exceptional Physician Award from UCSF.

Systemic neutralization of IL6 sensitizes IDH-wildtype glioblastoma preclinical models to immune checkpoint inhibition

Jacob S. Young, MD, Neurosurgery Resident, UCSF

Nam Woo Cho, MD PhD, Instructor, Department of Radiation Oncology, UCSF; Calixto-Hope G. Lucas, MD, Assistant Professor, Department of Pathology, Johns Hopkins University; Kanish Mirchia, MD Fellow, Department of Pathology, UCSF; Kyounghee Seo, BS, Preclinical Core, Brain Tumor Research Center, UCSF; William C. Chen, MD Instructor, Department of Radiation Oncology, UCSF; Minh Nguyen, BS Medical Student, UCSF; Joanna J. Phillips, MD PhD Associate Professor, Department of Pathology, UCSF; Tomoko Ozawa, MD PhD Preclinical Core, Brain Tumor Research Center, UCSF; Aparna Bhaduri, PhD Assistant Professor, David Geffen School of Medicine, UCLA; Manish K. Aghi, MD PhD Professor, Department of Neurosurgery, UCSF; Mitchel S. Berger, MD Professor, Department of Neurosurgery, UCSF; Nicholas Butowski, MD Professor, Department of Neurosurgery, UCSF; David R. Raleigh, MD PhDAssociate Professor, Department of Radiation Oncology, UCSF

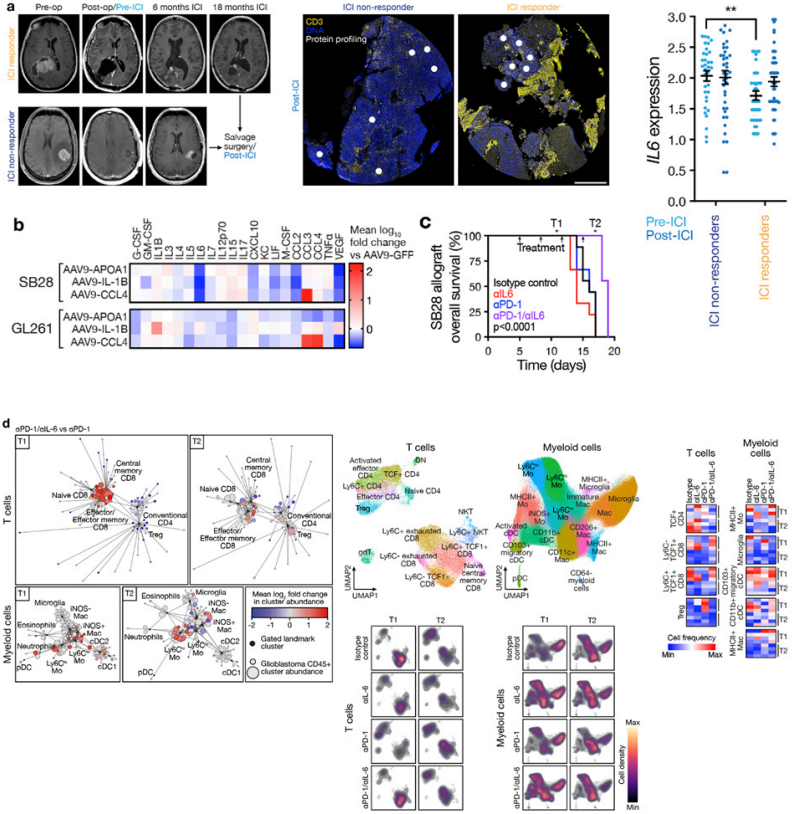
Introduction: IDH-wildtype glioblastomas are resistant to immune checkpoint inhibition (ICI). Here we integrate spatial and single-cell approaches across paired human glioblastomas before or after ICI with functional studies in immunocompetent intracranial mouse glioblastoma models to reveal mechanisms and therapeutic vulnerabilities underlying glioblastoma resistance to ICI.

Methods: Spatial proteomic and transcriptomic approaches were used to identify biochemical and gene expression programs underlying ICI response or resistance in paired human glioblastoma samples (n=7). Intracranial SB28 glioblastoma allografts were implanted in C57BL/6J mice and treated with (1) convection enhanced delivery (CED) of AAV9 gene therapy vectors encoding cytokines that reprogram the tumor immune microenvironment (TIME) in other cancers (Il1b, Ccl4, Apoa1), (2) systemic anti-PD1, (3) local anti-IL6, (4) systemic anti-IL6, or (5) combination systemic treatment with anti-PD1 and anti-IL6. Histological, mass cytometry (CyTOF), and multiplexed cytokine assays were used to assess the glioblastoma TIME in response to treatment over time. Mice were monitored for survival and tumor growth was measured using intracranial bioluminescence.

Results: Human glioblastomas with radiographic responses to ICI had lower pre-treatment IL6 levels on spatial profiling than glioblastomas resistant to ICI (**Fig 1a**). Intratumor IL6 was suppressed by all AAV9 cytokine conditions compared to AAV9-GFP in mice (**Fig 1b**). Mouse survival was improved by combination systemic treatment with anti-PD1 and anti-IL6, but was not improved by either antibody alone, or by anti-IL6 CED (**Fig 1c**). CyTOF revealed combination systemic therapy reprogrammed the glioblastoma TIME by increasing activated immune cell types such as MHCII+ monocytes, CD103+ migratory dendritic cells (DCs), CD11b+ conventional DCs, and effector CD8+ T cells, and by decreasing immunosuppressive Tregs (**Fig 1d**).

Conclusions: In summary, systemic anti-IL6 in combination with systemic anti-PD1 reprograms the glioblastoma TIME to sensitize preclinical models to ICI. These results provide mechanistic validation of findings from human glioblastomas that respond to ICI and shed light on a therapeutic vulnerability underlying the glioblastoma TIME.

Figure 1.



Neon signs, billboards and hot-dog carts are prohibited in the quaint village of Carmel-by-the-Sea, and a permit is required to wear high-heeled shoes.

2023 Clinical Science Resident Award Recipient

Gianna M. Fote, MD, PhD
University of California
Irvine

Gianna Fote completed her Bachelors of Science in Biology at Yale University, where she became president of the Undergraduate Biological Society and two-time intercollegiate water polo division MVP. She then matriculated to the MD/PhD program at UC Irvine. Her PhD thesis work on cellular dysregulation in Alzheimer's Disease was published in the Journal of Cell Science. During her PhD, she was awarded an NIH F30 Fellowship, and was an invited speaker at the International Gordon Seminar on autophagy. Throughout her PhD years Gianna led review sessions for the Medical Neuroscience course, volunteered to perform baseline concussion testing for NCAA athletes, and served as president of the UCI Neurosurgery interest group. Upon graduation, she was awarded the UCI Mind Cotman scholar award, the Meyskens Medical Research Award, the Vincent Carroll Memorial Research Award, and the Department of Neurological Surgery Outstanding Student Award. She looks forward to continuing her research with UCI Neurosurgery faculty on lysosomal storage disorders and hydrocephalus, and serving patients in Orange County during her residency at UCI.

Non-invasive intracranial pressure monitoring demonstrates treatment-responsive alterations in cerebral compliance in idiopathic Normal Pressure Hydrocephalus

Gianna M. Fote, MD, PhD, Department of Neurosurgery, University of California, Irvine

Alexander S. Himstead, MD[1], Bryce Picton, BS[1], Kevin O'Leary, BS[2], Cassie S. Poole, PA[1], Jefferson W. Chen, MD, PhD[1], [1]Department of Neurosurgery, University of California, Irvine,[2]Albert Einstein College of Medicine, New York

Introduction: Idiopathic normal pressure hydrocephalus (iNPH) may affect 700,000 patients nationally, causing progressive gait, cognitive, and urinary problems[1]. CSF diversion relieves these symptoms in some patients. NPH mechanisms are largely unknown, making diagnosis and predicting response to surgery challenging. These mechanisms may involve reduced cerebral compliance[2] and genetic risk factors. We employed novel non-invasive intracranial pressure (ni-ICP) monitors to assess cerebral compliance pre/post CSF diversion surgery, and explored a genetic variant potentially linked to reduced brain compliance in NPH patients.

Methods: With IRB approval, 10 iNPH patients (pre/post-op) and 4 controls were tested using the ni-ICP monitor for 5-minutes supine and 5-minutes with the head of bed (HOB) at 30°. Cerebral compliance was measured by P2/P1 ratio. Whole exome sequencing data from 69 NPH patients and 42 controls was analyzed using Fisher's exact test with multiple comparisons correction. Statistically significant variants enriched in NPH patients compared to controls and the general population (gnomAD3 database) was identified.

Results: Elevation of the HOB exacerbated poor compliance (higher P2/P1ratio) in NPH patients; this improved to control levels post-operatively (Figure 1A) ($p<0.05$). All NPH patients experienced symptomatic improvement at post-operative visits (85% improved gait and cognition, 71% improved bladder symptoms). A genetic variant of CTRP9, an anti-inflammatory, neuroprotective signaling molecule[3] was significantly enriched among NPH patients compared to controls and the general population (Figure 1B). This molecule is expressed in endothelium and is anti-atherosclerotic, potentially preserving vascular and intracranial compliance[4]. Among seven NPH patients that have been sequenced, six carried this variant.

Conclusions: Selecting patients who may respond to CSF diversion therapy may require a strategy incorporating existing imaging/clinical criteria with novel biomarkers including cerebral compliance and genetic risk may yield optimal results (Figure 1C). Investigation NPH pathogenesis and reduced intracranial compliance using ni-ICP monitoring may guide investigations into novel therapeutic strategies.

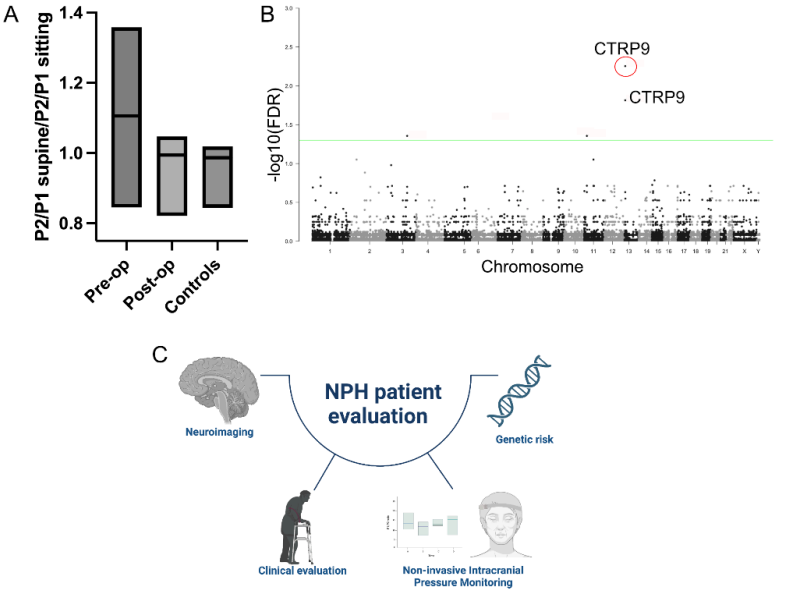


Figure 1. Biomarkers for NPH CSF diversion response. (A) P2/P1 ratio of patients while supine normalized to values while sitting. One-way ANOVA reveals a significant difference among means (P=0.05). T test comparing NPH patients pre-and post-operatively was also significant (P=0.04). **(B)** Manhattan plot demonstrating difference in variant frequency between NPH cohort (N=74) and a control group (42). Fisher's exact test with false discovery rate correction for multiple comparisons demonstrates significance for a CTRP9 variant. **(C)** Proposed multi-factorial evaluation of NPH patients incorporating multiple biomarkers to predict response to CSF diversion.

Scientific Session
Day 3, Session IV

Subperineural dissection for preservation of the facial nerve during resection of vestibular schwannoma: technique and outcomes in 145 patients

Jacob Ruzevick MD, Assistant Professor, University of Washington, Department of Neurological Surgery

[1]Thomas Hanks BS, [1]Zirun Zhao MD, [1]Haoyi Lei BS, [1]Jessica Eaton MD, [1]Evgeniya Tyrtova MD, [1]Spencer Raub BS, [2]Gavriel Kohlberg MD, [2]Jay Rubinstein MD PhD, [1]Samuel Emerson MD PhD, [1]Manuel Ferreira Jr MD PhD, [1]Department of Neurological Surgery, [2]Department of Otolaryngology/ Head and Neck Surgery

Introduction: Microsurgical resection of vestibular schwannomas (VS) may result in temporary or permanent facial nerve injury. Applying the subperineural technique during resection maintains a protective sheet of perineurium over the facial nerve and may limit iatrogenic injury during resection.

Objective: To assess the postoperative and long-term facial nerve outcomes following subperineural dissection of VS.

Methods: An IRB-approved, retrospective, single-institution cohort study of patients undergoing retrosigmoid approach and subperineural resection technique of VS between 2011 and 2022 was performed. The EMR was queried for patient demographics, clinical exam, operative details, intraoperative neuromonitoring, radiographic data, and postoperative clinical exam.

Results: A total of 145 patients were included for study of which 9 had NF2. The average cisternal transverse size was 2.0cm. A total of 115(79.3%) patients achieved GTR, of which 85.4% had postoperative HB1-2 facial nerve function, which improved to 97.4% at 1-year follow-up. Postoperative HB1-2 facial function in tumors measuring ≤1cm, 1-2 cm, 2-3 cm, and >3cm was 85.7%, 69.1%, 75.0%, 67.6%, respectively. This improved to HB1-2 facial function in 100.0%, 93.2%, 97.0%, and 90.0% of patients at 1-year follow-up, respectively. Following resection, stimulation of the facial nerve REZ at 0.05mA, 0.1-0.2 mA, and >.2mA occurred in 72.4%, 17.9%, and 9.7% of patients with HB1-2 facial function in 97.1%, 87.6%, and 75.0% of patients at 1-year follow-up, respectively. To date, a total of 4.4% and 22.2% of patients with sporadic and NF2 related VS experienced tumor recurrence following resection.

Conclusion: The subperineural technique for resection of VS involves preservation of the perineurium of the affected vestibular nerve, allowing a protective plane over the facial nerve and excellent post-operative outcomes related to facial nerve function.

Search for Novel Immunotherapy Targets in Glioblastoma Due to Alternative Splicing of Tumor mRNA

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Parvinder Hothi, PhD, Jae-Guen Yoon, PhD, Swedish Neurosciences Institute ; Brain Searle, PhD, Ohio State University

Glioblastoma (GBM) is the most malignant type of brain tumor, with a median survival time of 15 months. The standard of care for GBM (surgical resection, radiotherapy, and concomitant chemotherapy) is invasive, has lasting side effects, and has remained mostly unchanged for three decades. In this project, we will establish a new research angle by investigating unique alternative splicing events as potential therapeutic targets in GBMs. Aberrant alternative splicing is prevalent in other cancer types, and our preliminary results comparing paired GBM vs. normal adjacent brain biopsy samples indicate that alternative splicing in GBM affects many more genes than previously expected, both at the transcript and protein levels. Based on these data, we believe that aberrant splicing may be involved in tumor initiation and development. We hypothesize that a set of alternatively spliced genes are involved in GBM pathogenesis and can be used as potential diagnostic biomarkers and therapeutic targets. In this work, we use a combination of approaches aimed at detecting and quantifying tumor-specific alternative splicing events in GBM. We have access to a large biorepository of paired GBM and normal tissues, as well as the corresponding primary GBM stem cells. Our preliminary RNA-Seq data of some of these paired tumor/normal samples demonstrates that we can identify putative alternative splicing events in GBMs, yet we find that only a limited number of these novel transcripts produce functional proteoforms in tumor cells. We apply transcriptomics and proteomics technologies in parallel, where we identify candidate splicing isoforms with RNA-Seq and independently validate them using GeLC-MS/MS, a mass spectrometry technique that can distinguish different proteoforms produced by the same gene. These GBM-associated novel proteoforms derived from alternative splicing events may lead to novel immunotherapy targets.

Surgical Experience in Endoscopic Endonasal Resection of Craniopharyngioma in 66 Patients

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Introduction: Variations exist in surgical aproach and goals of surgery for management of craniopharygiomas. The objective of this study is to examine our practice pattern across 15 years using the endoscopic endonasal approach for resection of craniopharyngioma to further delineate the optimum management of patients with craniopharygiomas.

Methods: A retrospective chart review was conducted for all patients with a histological diagnosis of craniopharyngioma that underwent endosopic transphenoidal surgery for resection. Patients were stratified into three epochs to examine effects of treatment patterns and outcomes. A subgroup analysis of patients with primary craniopharyngioma management with stalk preservation and sacrifice was then conducted for rate of gross total resection, anterior pituitary function preservation, and development of new permanent diabetes insipidus.

Results: Gross total resection was significantly higher in the second epoch and third epochs compared to first (20% vs 65% vs 52%; p=0.042). Stalk preservation was significant higher in the first and third epoch when compared to the second epoch (75% vs 8.7% 52.2%; p=0.0001). Preservation of normal endocrine function was significantly higher in first and third epoch when compared with second epoch (25% vs 4.3% 26.51%: p=0.046). Only one patient had a post-operative CSF leak in the middle epoch and no patients had CSF leak in the latest epoch (40% vs 4.5**%** vs 0%, p=0.0001). Gross total resection was achieved at a significantly higher rate in the stalk sacrifice group (70.8% vs 28%, p=0.005). At last follow-up, there was no difference in recurrence/progression rate between stalk preservation and sacrifice group.

Conclusion: Our results indicate that there is a continuous learning curve in the management of craniopharyngioma. Gross total resection with higher rates of pituitary stalk preservation and hormonal preservation and low rate of post-operative CSF leak can be achieved with increased surgical experience.

Impact of Frailty on Outcomes in Patients with Cushing's Disease: Findings from the Multicenter RAPID Registry

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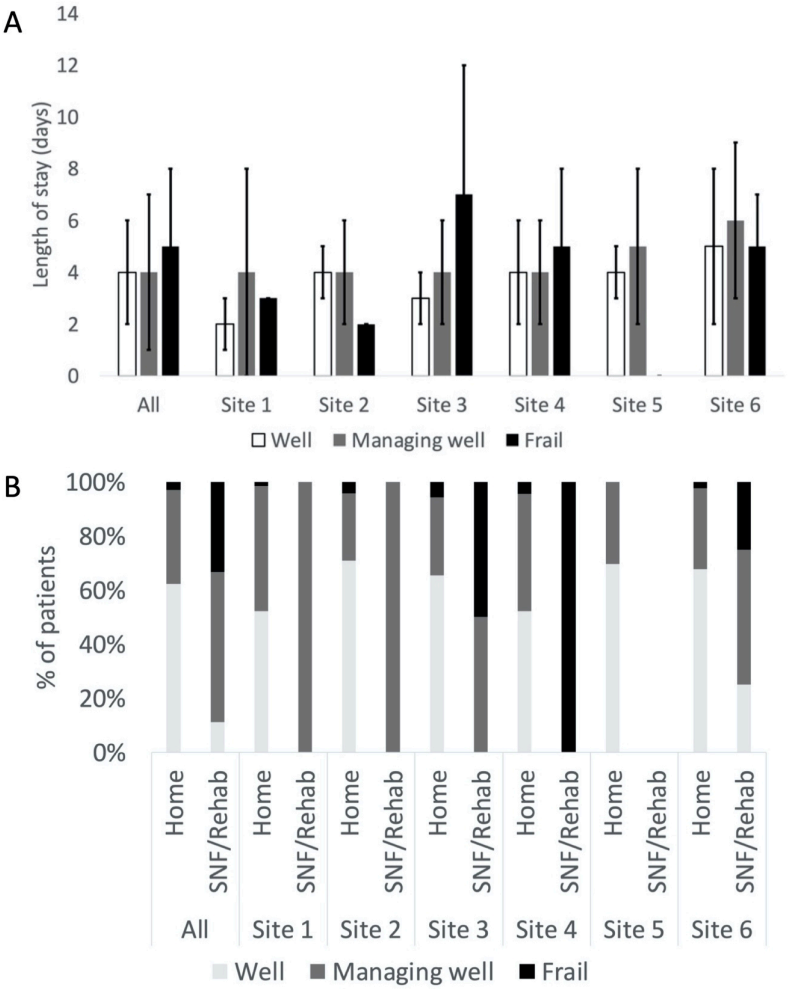
Objectives: Increased interest in the impact of patient frailty on patient outcomes has grown in neurooncology due to longer patient lifespans and improved surgical treatments. Cushing's disease (CD) remains notable due to the significant morbidity that unchecked hypercortisolemia alone can induce. We sought to evaluate the impact of frailty on outcomes with CD using the multicenter Registry of Adenomas of the Pituitary and Related Disorders (RAPID).

Methods: RAPID comprises 11 academic pituitary centers with both retrospective and prospective study arms. Retrospective patients were consecutively treated patients from 2011-2018. Patients with surgically treated corticotrophs were evaluated using a modified 11-factor frailty index. Patients were divided into well (score 0-1), managing well (score 2-3), and frail (score 4-5).

The 17-Mile Drive through Pebble Beach is one of only nine private toll roads in the country, and the only one west of Mississippi.

Results: Among 518 total patients, 193 well, 113 managing well and 12 frail patients were identified. Frail patients were older on average (40 vs. 49 vs. 49 years, $p<0.001$) but otherwise showed no difference in gender, race, or institutional location ($p>0.05$). Length of stay was higher for frail patients (3.7 vs 4.5 vs. 5.3 days, $p=0.02$) and this significance persisted after multivariate analysis adjusting for known predictors of prolonged hospitalization ($\beta=1.01$, $p=0.007$). Additionally, frail patients were more commonly discharged to skilled nursing facilities (0.5% vs. 5% vs. 25%, $p<0.001$). Most patients underwent a gross total resection with no differences between patient groups (84.4% vs. 79.6% vs. 83.3%, $p>0.05$). No significant difference in overall complications were seen ($p=0.34$) however venous thromboembolism was more common in frail patients (8.3%) compared with well (0.5%) or managing well (2.7%) patients ($p=0.04$). No differences in 90-day readmission rates were seen ($p=0.59$).
Conclusion: Frailty impacted CD patient outcomes beyond simply age or tumor characteristics and may be useful for patient prognostication. Further studies can help identify strategies to reduce disease burden for those with hypercortisolemia and high levels of frailty.



Custom Flexible MRI Receiving Coil Enables Ultrahigh Resolution Imaging of the Pituitary Gland

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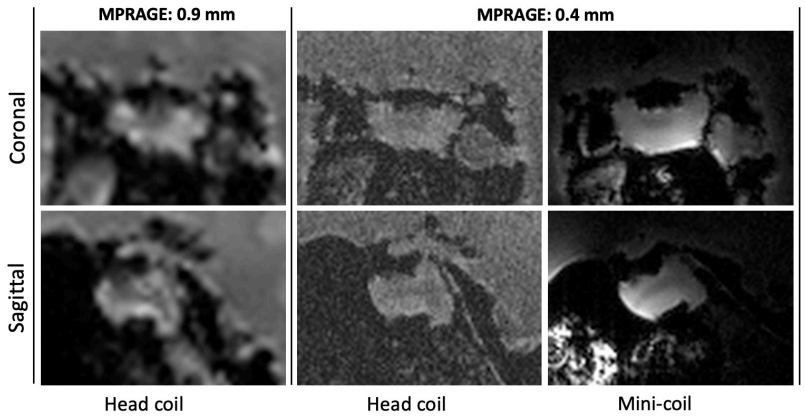
Kunal Patel MD, Sophie Peeters MD, Siyuan Liu PhD, UCLA Samueli School of Engineering; Rob Candler, PhD UCLA Samueli School of Engineering; Kyung Hyun Sung, PhD UCLA Department of Radiology

Introduction: The identification of a pituitary microadenoma in Cushing's disease remains elusive in up to 40% of patients despite high-resolution 3T clinical MRI. Low signal-to-noise ratio (SNR) is the main limitation of MRI resolution. SNR is related to magnet (Tesla) strength and the configuration of antenna coils, and inversely related to field of view (FOV) and distance from source to receiver coil. We constructed a prototype MRI antenna minicoil designed to be positioned immediately adjacent to the sella turcica with the aim of achieving higher SNR.

Methods: The prototype coil was positioned in the sphenoid sinus of cadaveric human heads utilizing a transnasal endoscopic approach. The cadaver heads underwent 3T MRI imaging using both the custom coil and a standard commercial Siemens 20-channel coil. SNR was estimated comparing the prototype transnasal coil versus a standard clinical head coil. One cadaver pituitary gland was explanted and histologically examined for correlation to the imaging findings.

Results: The image quality of the prototype coil was subjectively superior at higher spatial resolutions relative to the commercial 20-channel head coil. The custom coil allowed suitable imaging at 0.4 mm isotropic voxel size. An average 17-fold increase in SNR relative to the head coil was achieved within the pituitary gland. Subtle findings visualized only with the transnasal coil had potential pathological correlates on immunohistochemical analysis.

Conclusions: The 17-fold boost in SNR provided by the in-body coil at 3T may be, in principle, equivalent to 51T scanner using a standard head coil. The improved quality and resolution of pituitary imaging may be helpful in the reliable identification and subsequent surgical resection of pituitary tumors as small as 2 mm in diameter.



Treatment of Cauda Equina Symptoms from Perineurial Cysts: Examination of an Extrinsic Wrapping Surgical Approach

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Introduction*:* Perineurial cysts, known eponymously as Tarlov cysts, can cause cauda equina symptoms and intracranial hypotension. The optimal treatment is unknown. The earliest surgical approach was excision, first performed by Tarlov in 1948. Contemporary surgical techniques include both intrinsic (intra-dural/nerve root sheath) and extrinsic (extra-dural/nerve root sheath) approaches. This study examines an extrinsic wrapping technique which allows for the preservation of the cyst wall and reconstruction of normal anatomy.

Methods*:* A retrospective study involving 237 patients who had Tarlov cyst wrapping was conducted, with 49 patients responding to a request for study participation. The North American Spine Society (NASS) Satisfaction Measure was administered. Oswestry Disability Index (ODI) and Urogenital Disability Index (UDI-6) scores were collected pre-surgery via chart review and post-surgery via administered questionnaires to assess the effectiveness of the extrinsic wrapping surgical approach.

Results*:* The follow-up time ranged from 4.85 to 75.94 months, with a mean of 30.48 months. Most respondents (87.3%) were satisfied with their treatment. The mean pre-surgery ODI score was 46.58, which decreased to 25.12 post-surgery, indicating an improvement in patients' functional disability. Similarly, the mean pre-surgery UDI-6 score was 7.12, which decreased to 4.49 post-surgery, indicating an improvement in urogenital symptoms. The paired samples test showed a statistically significant decrease in both ODI and UDI-6 scores after surgery ($p < 0.001$ and $p = 0.002$ respectively). However, post-surgical complications were reported by a subset of patients, with saddle anesthesia being the most common (N=4). No post-operative CSF leaks were recorded.

Conclusion*:* The wrapping surgical approach is a consideration in the surgical treatment of symptomatic perineurial cysts. The statistically significant decrease in ODI and UDI-6 scores post-surgery suggests an improvement in patients' functional and urogenital disability. However, the presence of post-surgical complications underscores the need to identify positive and negative prognostic factors in patient selection.

Scientific Session
Day 3, Session V

Mastoiditis Related Epidural Abscesses Evacuation Through a Transmastoid Approach: A Case Series

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Introduction: Acute otitis media (AOM) is one of the most common diseases among pediatric patients with 46% of healthy infants experiencing at least one AOM episode by their first birthday. AOM can result in both intratemporal and intracranial complications including mastoiditis, facial nerve palsy, epidural abscess, subdural empyema, brain abscess, and venous sinus thrombosis. While the need for close collaboration between otolaryngology and neurosurgery providers when treating patients presenting with mastoiditis and associated intracranial complications is clear the literature is sparse with respect to reports of mastoidectomy being combined with a transmastoid approach to address concomitant intracranial pathology.

Methods: A retrospective chart review of three patients presenting with mastoiditis and associated epidural abscesses primarily situated within the posterior aspect of the middle cranial fossa who underwent surgical intervention between Jan 19, 2023 and March 6, 2023 was performed in conjunction with a literature review.

Results: All three pediatric patients underwent mastoidectomy via a postauricular incision with middle cranial fossa epidural abscess evacuation performed during the same operation via creation of a small (<0.5cm) defect in the mastoid tegmen with a high-speed bur. In two cases non-suturable Duragen was applied to the exposed dura via the small tegmen defect created. There were no intraoperative complications. All three patients completed postoperative courses of intravenous antibiotics, demonstrated excellent radiographic responses to the surgical intervention, and made complete recoveries.

Conclusions: When mastoidectomy is indicated for the management of a patient with mastoiditis and an associated underlying epidural abscess our experience demonstrates that it is safe and feasible to perform epidural abscess evacuation via a transmastoid approach. Long-term follow up is necessary to ensure that late acquired encephaloceles do not arise but we feel this is unlikely given the small dimensions of the mastoid tegmen opening created.

Engineering Artificial Sensation for a Closed-loop Motor / Sensory Brain-Computer Interface

Brian Lee, MD Ph.D, Department of Neurological Surgery, Keck School of Medicine of USC

Daniel Kramer, MD, Michelle Armenta Salas, Ph.D, Spencer Kellis, Ph.D, David Brown, Ph.D, Tatyana Dobreva, Ph.D, Christian Klaes, Ph.D, Christi Heck, MD, Charles Liu, MD Ph.D, Richard A. Andersen, Ph.D

Introduction: Somatosensory feedback is a critical aspect of motor control in closed-loop brain-computer interfaces (BCIs). Current human studies have demonstrated the ability to generate sensory information via BCIs, although further testing is needed to understand the effect of varying stimulation parameters on perceived sensation. Here, we report a systematic evaluation of generating percepts of somatosensation in humans via cortical stimulation of subdural mini-electrocorticography (mini-ECoG) grids placed on the hand region of primary somatosensory cortex (S1).

Methods: Nine patients with epilepsy undergoing placement of cortical electrodes for seizure localization were also implanted with a subdural 64-channel mini-ECoG grid over the hand region of S1. We mapped the somatotopic location and size of receptive fields evoked by stimulation of individual channels of the mini-ECoG grid. We determined the effects on perception by varying stimulus parameters of frequency, amplitude, and pulse width. Finally, a target localization task was used to demonstrate the use of artificial sensation in a behavioral task.

Results: We found reproducible somatotopic representation of the hand on the mini-ECoG grid across most participants during electrical stimulation. The stimulus-evoked sensations were usually of unnatural quality, but in some cases, were more natural and of a cutaneous or proprioceptive nature. Increases in frequency, amplitude, and pulse width generally produced similar quality sensations at the same somatotopic location, but with a perception of increased intensity. The participants had near perfect performance when using the evoked sensory information in target acquisition tasks.

Conclusions: These findings indicate that electrical stimulation of somatosensory cortex through mini-ECoG grids has significant potential for restoring somatosensation in patients for a closed-loop motor / sensory BCI.

A group of resting otters is called a raft.

Robotic Endoscopic Third Ventriculostomy: A Pediatric Retrospective Cohort Study of Operative Time

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Introduction: Endoscopic third ventriculostomy (ETV) is a common intervention for pediatric hydrocephalus that can be combined with other procedures, such as a cyst fenestration or biopsy. The ability to harness robotic technology for dual procedures is plausible, although whether doing so increases the time of the ETV portion of the case is unknown.

Methods: All endoscopic third ventriculostomy procedures performed between 2015 and 2020 by a single surgeon at a quaternary pediatric hospital were reviewed. All combined ETV cases were excluded. Endoscopic or robotic operative assist was recorded. Operative time was recorded. All statistics were performed with R.

Results: A total of 91 patients were included in our analysis. 50 patients underwent non-robotic or traditional ETV and 41 underwent robotic ETV. The total average age was 5.45 years, with a minimum of 0.1 and maximum of 20.7. The average age in the non-robotic ETV group was 3.0 and in the robotic group was 8.6. The most common diagnosis overall was aqueductal stenosis, in the non-robotic group was unspecified hydrocephalus, and in the robotic group was hydrocephalus secondary to brain tumor. The average operative minutes, documented by nursing as “procedure start” and “procedure finish” in the non-robotic group was 45.78 (min 15, max 148) and in the robotic group was 41.6 (min 16, max 114). This difference is not statistically significant, $p=0.41$.

Conclusion: Robotic ETVs are fast, efficient procedures with comparable operative times to traditional endoscopic procedures. They provide additional advantages of smaller incisions, the ability to perform this procedure in small ventricles, and ease of performing simultaneous stereotactic biopsy from a second trajectory.

Disparities in communication patterns among Spanish-speaking patients with hydrocephalus

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Introduction: Spanish speakers make up a significant proportion of the United States population, however, there is limited research exploring pediatric neurosurgical outcomes among Spanish-speaking patients (SSPs). We investigated whether there are differences in communication patterns or healthcare utilization among English-speaking patients (ESPs) and SSPs with hydrocephalus.

Methods: The medical record was queried to identify patients with a ventriculoperitoneal shunt (VPS) or endoscopic third ventriculostomy (ETV). Fifty ESPs and fifty SSPs aged < 18 years old were selected. Demographics, communication patterns with clinic, and healthcare utilization patterns were collected. Multiple linear regressions were run to assess the significance of predictors on communication frequency and utilization.

Results: SSPs were more likely to have a comorbidity than ESPs ($p<0.01$), and were more likely to have a VPS ($p<0.01$). SSPs had longer median postoperative length of stay (LOS) ($p<0.01$) and 30-day readmission ($p<0.01$) versus ESPs. Only 18% of SSPs communicated with clinic postoperatively ($p<0.01$), with 11 total calls/ messages from SSPs versus 57 total by ESPs ($p<0.01$). Outreach from ESPs most frequently resulted in a change in medical course or reassurance handled in outpatient basis (30% ESP vs. 0% SSP, $p=0.04$), whereas those from SSPs most frequency resulted in guidance to present to the ED (3% ESP vs. 36% ESP, $p<0.01$). Language remained a statistically significant predictor for numbers of calls or messages sent even after controlling for comorbidity, operation type, race, ethnicity, and insurance type ($p<0.01$).

Conclusion: SSPs undergoing surgery for hydrocephalus were more likely to have a comorbidity, longer postoperative LOS, and all-cause 30-day readmission. Despite having more complex disease, only 18% of SSPs communicated with the neurosurgical clinical team postoperatively and were more frequently sent to the ED for management. Further research is now exploring communication barriers among SSPs to ensure high-quality care that is timely, equitable, and patient-centered.

Responsive neurostimulation of the pulvinar for medication refractory epilepsy: a case series

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Introduction: Responsive Neurostimulation (RNS) has become a widely utilized method for treatment of medication refractory epilepsy in both focal onset and generalized epilepsy. The volume of patients and literature that describes the outcomes of implants in the centromedian (CM) nucleus and the anterior nucleus (AN) is growing rapidly. The pulvinar has been implicated in posterior quadrant epilepsy but reports of outcomes are limited.

Methods: The Neuropace data and electronic medical records of all patients with pulvinar RNS at the University of Washington were retrospectively reviewed.

Results: A total of four patients with at least one pulvinar RNS lead were identified. All patients underwent extensive treatment trials prior to implant. Three patients underwent intracranial EEG (iEEG) monitoring which confirmed, non-resectable, unilateral posterior quadrant seizure onset zone. These patients underwent unilateral pulvinar depth placement with additional, ipsilateral posterior quadrant strip or depth. The fourth had confirmed bilateral posterior quadrant epilepsy identified on scalp EEG. Two patients implanted in 2021 have shown worthwhile (at least Engel III) seizure reduction, with one reporting complete seizure freedom. Two patients implanted in 2022 have shown improvement in seizure burden. The most recent of these patients (the bilateral implant) is reporting only 1 clinical tonic seizure since initiating stimulation, a marked improvement from baseline, and improvements in communication and behavior. All patients remain relatively early in programming in comparison with prior literature on RNS outcomes.

Conclusions: Early outcomes suggest that pulvinar nucleus RNS implantation is a safe, viable option for medication refractory posterior quadrant epilepsy. Beneficial seizure reduction has been seen in patients who have been implanted for at least 1 year, while patients with more recent implants have shown some seizure improvement with initial programming. These patients should be followed closely and long-term data should be collected. Optimization of detection and stimulation should be continually studied.

Congenital lumbar epidermoid cyst with associated ossification

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Gabrielle E.A. Hovis[1], MD, Isaac Yang[1], MD [1] Department of Neurosurgery, University of California, Los Angeles

Introduction: Epidermoid tumors, or cysts, are rare, benign neoplasms found along the neuroaxis. Congenital epidermoid cysts (EC) are believed to be inclusions of cutaneous ectoderm resulting from aberrant implantation during neurulation. ECs can also be acquired through the displacement of epidermal tissue into the subdural space during lumbar puncture or surgical trauma. While most epidermoid tumors are located in the cranium, a minority arise in the spine; comprising less than 1% of all spinal neoplasms. While calcification of spinal ECs is rare (with only two reported cases), ossification with mature bone formation has never previously been documented. We present a case report of the only known congenital lumbar epidermoid tumor with associated ossification, and literature review of intradural, extramedullary lumbar EC

Methods: The PubMed database was queried using the terms “spinal,” “lumbar,” and “epidermoid” alone and in combination. Studies that met the following criteria were included: 1) epidermoid cyst as the primary tumor type, 2) intradural and extramedullary location, 3) involvement of the lumbar spinal level, and 4) primary presentation. Studies were excluded if they lacked individual patient data or were published in a non-English language. Patients with recurrent or malignant neoplasms were excluded. Descriptive statistics were performed using RStudio.

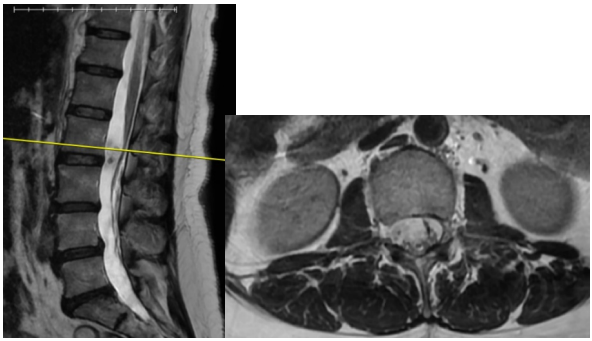
Results: A total of 172 studies were returned from the search and 43 were included in analysis. Individual patient data was available for 83 patients, 37 (45%) male and 45 (55%) female, at an average age of 26 years. The most frequently involved spinal levels were L3 and L4, each with 38 cases. Acquired etiology was reported in 49 (67%) patients, and there were 24 (33%) cases of congenital origin. Spinal dysraphism or other associated congenital anomalies was reported in 13 (16%) individuals. Prior lumbar puncture was recorded in 43 patients (52%), lumbar surgery in six (7%) cases, and lumbar discography in one (1%). Any calcification of the neoplasms was reported in two (2%) cases, both of which were iatrogenic after several prior lumbar punctures and located at the L4 level; No cases of associated ossification was identified.

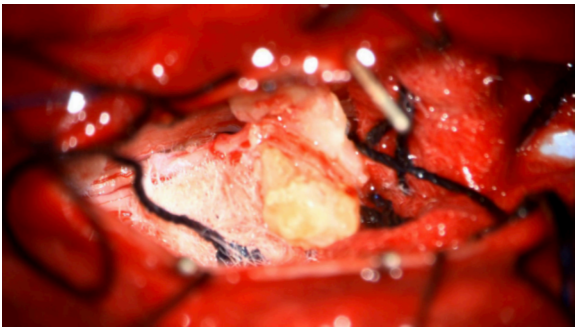
Our patient was a 55-year-old female who presented with six months of severe 9/10 chronic lower back pain with left lower extremity non-dermatomal numbness, paresthesia, and non-focal subtle leg weakness with unsteady ambulation. She denied radiculopathy, but did have severe bilateral pain in her feet. MRI demonstrated a 2cm L2/3 intradural T2 hypointense lesion with a minimal focal area of contrast enhancement. CTA chest-abdomen-pelvis and MRI of the neuroaxis was negative for other lesions; the patient denied any prior lumbar punctures, traumas, or spinal anesthesia/procedures.

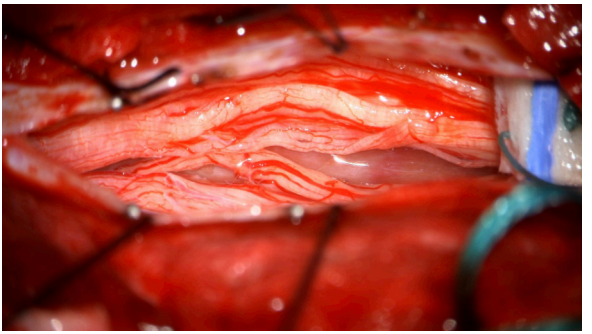
After laminectomy and dural opening, a hard, ossified lesion with a focal area of soft, flakey, tumor was identified; the firm portion was circumferentially encasing a traversing nerve root. A trough was painstakingly drilled through the ossification using ultrasonic aspiration in order to release the nerve. After gross total resection of the tumor, the intradural space was copiously irrigated with hydrocortisone irrigation and closed in watertight fashion. Postoperatively, the patient experienced resolution of her pain, normalized sensation, and improved strength/ambulation. Pathology demonstrated loose keratin, consistent with the contents of an epidermoid cyst, and ossification with mature bone; no atypia or malignancy was appreciated.

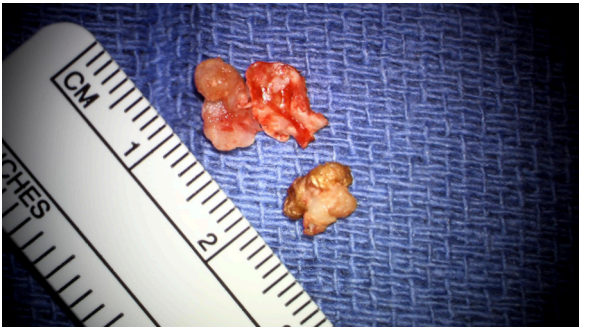
Of the two iatrogenic calcified ECs identified in the literature, the first patient, a 45-year-old female, had undergone lumbar punctures for meningitis in childhood and lumbar anesthesia at age 35. She underwent microscope-assisted resection and experienced bowel and bladder dysfunction postoperatively, but the tumor did not recur. The second patient, a 61-year-old female, had a history of low back pain with negative magnetic resonance imaging, which was treated with lumbar anesthesia more than 70 times over the 14 years leading up to her diagnosis. The patient underwent successful laminectomy and removal of the EC.

Conclusion: We present a case report of the only known congenital ossified lumbar 2/3 epidermoid tumor and provide a comprehensive review of 83 patients with primary intradural, extramedullary lumbar ECs which have been described in the English literature to date. The most common levels of involvement were L3 and L4, consistent with the predominant iatrogenic etiology secondary to prior lumbar puncture. Calcification was noted in only two of these cases. To our knowledge, this is the first characterization of calcified or ossified spinal ECs.





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Scientific Session
Day 3, Session VI

Association of Repetitive Traumatic Brain Injury with Longitudinal Recovery at 1 Year and 3-7 Years Post-Injury

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Objective*:* Acquiring one traumatic brain injury (TBI) increases the risk of subsequent TBIs. Research on longitudinal outcomes after repetitive TBIs is limited. Our study investigated associations between sustaining ≥1 TBIs *after* enrollment ("post-index TBI") and outcomes at 1-year and 3-7-years post-injury.

Methods*:* The prospective, 18-center Transforming Research and Clinical Knowledge in Traumatic Brain Injury study enrolled subjects who presented to emergency department and received a clinically-indicated head CT within 24h of TBI. Subjects aged ≥17-years with 1-year (N=1,572) and 3-7-year outcomes (N=1,084) were included. Clinical and outcomes variables were compared in subjects with versus without post-index TBI. Outcome measures included: functional [Glasgow Outcome Scale-Extended (GOSE)], post-concussional [Rivermead Post-Concussion Symptoms Questionnaire (RPQ)], psychological distress [Brief Symptom Inventory-18 (BSI-18)], depression [Patient Health Questionnaire-9 (PHQ-9)], post-traumatic stress disorder [PTSD; PTSD-Checklist 5 (PCL-5)], and health-related quality of life [HRQOL; Quality of Life After Brain Injury-Overall Scale (QOLIBRI-OS)]. Adjusted mean differences (aMD), relative risks (aRR) and 95% confidence intervals [CI] were reported.

Results*:* Overall, 3.2% and 12.2% of subjects had post-index TBIs at 1-year and 3-7 years, and 2.4% sustained multiple post-index TBIs at 3-7 years. Risk factors for post-index TBI included psychiatric history, prior TBI, and extracranial injury severity. At 1-year, post-index TBI was independently associated with incomplete functional recovery (GOSE=8; aRR=0.57 [0.34-0.96]); lower HRQOL (QOLIBRI-OS: aMD=-15.9 [-22.6, -9.1]); and greater post-concussional, psychological distress, PTSD, and depression symptoms (RPQ: aMD=8.1 [4.2-11.9], BSI-18: aMD=5.3 [2.1-8.6]; PCL-5: aMD=7.8 [3.2-12.4]; PHQ-9: aMD=3.0 [1.5-4.4]). At 3-7 years, these effects remained significant at reduced magnitudes. Multiple post-index TBIs were associated with poorer outcomes across all domains.

Conclusions*:* Post-index TBI is independently associated with greater symptomatology across outcome domains at 1- and 3-7 years, and exhibited dose-dependent responses with multiple post-index TBIs. These results underscore the need to provide TBI prevention and education, counseling, and follow-up care to at-risk patients.

Seizure Etiology on the Long-Term Outcome of Hemispherectomy

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Introduction: This study was undertaken to describe the typical patient by etiology undergoing a hemispherectomy, to qualify and quantify the impact of etiology on short and long-term hemispherectomy seizure outcome, and to understand the impact of vertical versus lateral hemispherectomy approach on short and long-term seizure outcome by etiology under the theory that certain etiological substrates may be more amenable to undergoing a vertical approaches (eg. more cortical atrophy) and thus have improved outcomes.

Methods: We conducted a post-hoc subgroup analysis of the HOPS (Hemispheric Surgery Outcome Prediction Scale) study, an international, multicenter, retrospective cohort study that identified predictors of seizure freedom through logistic regression modeling. Only patients with pathology confirmed seizure etiologies of porencephalic cyst (PC)/stroke, malformations of cortical development (MCD), hemimegalencephaly (HME), Rassmussen's encephalitis (RE), and Sturge-Weber syndrome (SWS) were included. Differences in seizure freedom rates were assessed using a time-to-event method and calculated using the Kaplan-Meier survival method.

Results: From the original HOPS database, 1,107 participants had data on their specific seizure etiology as determined by final pathology available. The most common etiology was PC/stroke (41.3%) followed by MCD (22.4%), HME (16.6%), RE (14.5%), and SWS (5.1%). Seizure freedom rates at 5-year follow-up were highest in PC/stroke (78.5%, 95%-CI=73.2-82.8%) followed by SWS (74.0%, 95%-CI=52.4-86.9), RE (63.1%, 95%-CI=53.9-71.0%), MCD (62.6%, 95%-CI=54.9-69.3%), and HME (50.0%, 95%-CI=40.7-58.6%). Using stroke as the baseline seizure etiology, RE, MCD, and HME patients had statistically significant faster time-to-seizure recurrence after hemispherectomy.

Conclusion: This study demonstrated post-hemispherectomy seizure freedom durability by seizure etiology from the most to least durable at five-year follow-up: PC/stroke patients, SWS, MCD, RE and HM. Sub-analysis suggest that vertical hemispherectomy may achieve longer seizure freedom than lateral hemispherectomy in atrophic etiologies (stroke, SWS, RE) than dysplastic etiologies (MCD, HM), a trend that persists but does not reach significance.

Novel Focus of Seizure Recurrence after Temporal Lobe Epilepsy Surgery: the Fasciola Cinereum of the Hippocampal Tail

Ryan Jamiolkowski MD PhD, Stanford Neurosurgery

Quynh Anh Nguyen PhD, Stanford Neurosurgery; Jordan Farrell PhD, Stanford Neurosurgery; Ryan McGinn MD, Stanford Neurology; Jeff Nirschl MD PhD, Stanford Pathology; Vivek Buch MD, Stanford Neurosurgery; Ivan Soltesz PhD, Stanford Neurosurgery

Introduction: The posterior-medial tail of the hippocampus is not thought to be a significant seizure source. However, 30-40% of temporal lobe epilepsy (TLE) patients recur after surgery, suggesting the existence of yet unidentified epileptic foci. The primary gray matter structure in the posterior-medial hippocampal tail is the fasciola cinereum (FC), an under-studied hippocampal subfield. In this study, we perform the first systemic targeting of this region in both human and mouse subjects, and show that it is a targetable source of seizure recurrence.

Objective: We used the intrahippocampal kainate mouse model of TLE, and sEEG in human patients to investigate the FC's role in epilepsy and determine if it is a therapeutic target.

Methods: sEEG were recorded from the the FC in six TLE patients, including one who had failed prior mesial temporal laser ablation. In epileptic mice, a light and Ca^{2+}-dependent molecular integrator (scFLARE) labeled cells that are active during seizures, and 2-photon imaging recorded activity of individual FC neurons during seizure. An inhibitory optogenetic channel was expressed in the FC, while light was delivered during seizures via closed-loop system.

Results: sEEG identified the FC as the source of recurrence after failed mesial temporal ablation, and that patient's seizure burden improved after repeat ablation of that remnant. The FC was involved in seizure onset for five other patients who had not yet had surgical intervention. In epileptic mice, scFLARE demonstrated that the FC was among the most active foci of seizure activity, and 2-photon imaging of FC neurons showed firing dramatically increased during ictal and inter-ictal spikes. Finally, seizures were shorter when light was delivered to the inhibitory opsin in the FC.

Conclusion: The FC is a major (and intervenable) seizure focus in both human patients and a mouse model of TLE, and is a novel surgical target for sEEG and ablation.

Establishing a Benchmark for Iatrogenic Hemodilution and Blood Transfusion in Long-Segment Spine Fusion Surgery

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Introduction: Perioperative transfusion for patients undergoing long-segment thoracolumbar fusion surgery is common. To date no work has been done to standardize intra- and perioperative management of transfusion administration. We sought to identify risk factors for transfusion, and further the analysis by identifying benchmark cutoffs that could be utilized by the operative team to guide transfusion. This data will be used to create perioperative protocols with the goal of decreasing transfusion rates when not indicated, and earlier administration when indicated.

Methods: A single-center retrospective cohort study of thoracolumbar fusion surgeries of 8 or more levels at our institution between 2015 and 2020 was conducted. Patient demographics, surgical details, anesthesia and critical care records, and laboratory data were compared between patients who received intraoperative and postoperative blood transfusions and those who did not. Univariate and multivariate propensity-matched analyses were performed to identify independent predictors for blood transfusion, and ordinal analysis was performed to identify possible benchmark cutoffs.

Results: We identified 233 patients undergoing long-segment fusions, of whom 133 (57.1%) received a blood transfusion. Multivariate propensity-matched logistic regression showed that IVF volume was an independent predictor for transfusion (total IVFs (8051mL transfusion vs 5070 non-transfused, $p<0.01$). Patients who received ≥4L total IV fluids were more likely to undergo transfusion compared to those who received <4L (93.2% vs. 50.7%, $p<0.01$). Those receiving IVF at a rate ≥60mL/Kg total IVFs (OR 10.45; 95% CI: 2.62-41.72, $P<0.01$), or ≥9mL/Kg/hr intraoperative IVFs (OR 4.46; 95% CI: 1.39-14.32, $P<0.01$) were likely to require transfusions**.**

Conclusion: IVF administration is an independent predictor for blood transfusion after long-segment fusion surgery. Limiting IVF administration may prevent iatrogenic hemodilution and decrease transfusion rates.

3-Level ACDF vs. 3-Level Laminectomy and Fusion: Are There Differences in Outcomes? An Analysis of the QOD CSM Cohort.

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Introduction: Prior studies comparing anterior versus posterior approaches for multilevel cervical spondylotic myelopathy (CSM) are limited by the heterogeneity of surgical technique.

Methods: The prospective QOD CSM cohort was queried for fusions across only three interspaces. Surgeries crossing the cervicothoracic junction were excluded. The cohort was divided into anterior cervical discectomy and fusion (ACDF) and posterior laminectomy and fusion. Rates of reaching minimum clinically important difference (MCID) for patient-reported outcomes were compared at 24 months after anterior versus posterior approaches.

Results: Of 199 patients [123 anterior versus 76 posterior fusions], 24-month follow-up rates were similar (ACDF: 90.2% vs. 92.1%,p=0.67). Preoperatively, ACDF were younger (60.8±10.2 vs 65.0±10.3yr, p<0.01), privately insured (56.1% vs. 36.8%,p=0.02), actively employed at the time of surgery (39.8% vs. 22.8%,p=0.04), and independently ambulatory (14.6% vs. 31.6%,p<0.01). Otherwise, the cohorts had equivalent baseline mJOA, NDI, NRS Arm Pain, NRS Neck Pain, and EQ-5D (p>0.05). ACDF had lower length of stay (1.6 vs. 3.9days,p<0.01) and non-routine discharge (7.3% vs. 22.8%,p<0.01) but higher postoperative dysphagia (13.5% vs. 3.5%,p=0.049). Both groups demonstrated improvements in all outcomes at 24mon, compared to baseline (p<0.05). In multivariable analyses, ACDF was associated with the greatest 24-month NASS Satisfaction (NASS 1 score) (69.4% vs. 53.7%, OR=2.44,p=0.02). Otherwise, the cohorts shared similar 24-month patient-reported outcomes. There were no differences in 3-month readmission (4.1% anterior vs. 3.9% posterior fusion,p=0.97) and 24-month reoperation rate (13.5% anterior vs. 18.6% posterior fusion,p=0.36).

Conclusion: In a cohort limited to 3-level surgeries, ACDF was associated with reduced blood loss, shorter lengths of hospitalization, and higher routine discharge rates; however, posterior cervical fusion resulted in lower rates of postoperative dysphagia. After controlling for confounders, the ACDF cohort had a significantly higher odds of maximum satisfaction. Patients should be counseled on the risks and benefits of each approach, given relatively comparable outcomes.

Functional Magnetic Resonance Imaging Based Language Center Localization Protocol Identifies Language Centers and Results in Clinical Outcomes Similar to Awake Intraoperative Testing

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Introduction: The goal of surgery in intra-axial brain tumors near eloquent language areas is maximal resection with preservation of function. Awake intraoperative cortical stimulation is the standard of care for evaluating functional areas intraoperatively. Functional magnetic resonance imaging (fMRI) is a non-invasive tool that may help evaluate these areas without the risks of awake monitoring, but current techniques yield low (20-60%) specificity.

Methods: We describe a detailed single-center protocol for fMRI for tumor resection in proximity to eloquent language centers including detailed pre-operative neuropsychology evaluation, image acquisition with diffusion tensor imaging and functional data post-processing, fusion to thin slice (1mm) anatomic imaging, integration into neuro-navigation (BrainLab, Munich, Germany), and intraoperative use. We report retrospective outcomes of 110 patients undergoing surgery for intra-axial brain tumor near functional language centers with language fMRI (approximately 50% with additional awake testing). In addition, we report prospective data in 10 patients comparing language localization by fMRI and awake testing.

Results: Broca's area, Wernicke's area, basal temporal language area, and arcuate fasciculus fibers are reliably identified and visualized on intraoperative neuro-navigation software. We report heterogeneity of language center overlap in patients with multiple languages. We find no significant differences in extent of resection, post-operative language deficits, progression free survival, and overall survival between patients with our fMRI-based language localization protocol alone versus fMRI language identification with awake cortical language testing, normalizing for clinical factors and pathology. We show > 90% sensitivity and specificity in our fMRI-based language center protocol for identifying Broca's area and Wernicke's area relative to awake intraoperative cortical stimulation with naming and comprehension tasks.

Conclusions: Together, these results suggest that our fMRI-based protocol robustly identifies language centers of the brain, including fiber tracts. We believe that in cases not suitable for awake intraoperative testing, this protocol may allow for improved extent of resection and preservation of eloquent language centers.

“Idiopathic” Subdural Hematomas and the Importance of a Detailed Patient History; a Case Series and Review of the Literature

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Joseph Falcone MD, Cassie Poole PA-C, Jefferson Chen MD PhD

Introduction: Subdural hematomas (SDHs) typically present with relatively clear causes: head trauma, coagulopathies, or underlying vascular or neoplastic pathology. Still, there remains a subset of patients without clear etiologies, raising unique management challenges. We present a series of cases of SDHs without classic etiologies, but with low mechanistic injuries not identified on initial presentation. We hope to highlight the low mechanistic forces experienced in our daily lives as causes of SDHs, as well as the importance of obtaining thorough history at initial presentation to effectively diagnose and manage these patients.

Methods: This case series was collected at a tertiary medical center by retrospective review of patients’ charts. Patient’s were chosen if they had minor mechanisms of injury and no identifiable coagulopathy or alternate pathology. A literature review was also performed using the PubMed database to identify similar cases for comparison.

Results: A total of seven cases from our institution are presented. Two patients with repetitive forceful head shaking. Two patients with Normal Pressure Hydrocephalus (NPH) with ventricular shunts with unique behavioral habits: a headbutting ritual and forceful diving into bed. Three with hobbies - riding roller coasters, firing high-powered rifles, and skydiving - that imposed high acceleration/deceleration and rotational forces. All patients presented only with headache, and none had neurological deficits or required surgery.

Conclusions: Patient’s with SDHs without typical etiologies can lead to missed diagnoses and unnecessary workup and resource use. This review highlights the importance of identification of the potential etiology of the SDH in obviating recurrence and avoiding the need for surgical intervention, particularly as the demands of a Neurosurgeon limit the ability to devote time to a thorough assessment. Without a clear history of trauma in a patient with a SDH, care must be taken to identify the etiology for effective, efficient, and lasting management.

Bypasses to Treat Complex Intracranial Aneurysms: Present Indications, Techniques, and Long-term Results

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Introduction: Microsurgical techniques and indications for cerebral bypasses have evolved considerably with the advent of endovascular flow diversion technologies but remain necessary for certain rare, complex

Objective: To analyze and describe indications, clinical outcomes and patency rates of cerebral bypasses for intracranial aneurysms spanning a 17-year period.

Methods: We retrospectively reviewed all intracranial bypass procedures performed by the senior author between 2005-2022. Demographic, clinical and radiological data were collected till the most recent follow-up. Statistical analysis was performed to characterize associations of bypass type (extracranial-to-intracranial vs local), aneurysm location (anterior vs posterior), aneurysm rupture status, and prior treatment status with graft patency and clinical outcomes (modified Rankin scores).

Results: During this period, 203 patients with 207 cerebral aneurysms were treated with 233 cerebral bypasses. The average follow-up time in the aneurysm group was 2 years. 166 (80%) were located in the anterior circulation (79.4%) and 41 (20.6%) in the posterior circulation. One-third of aneurysms (n=73, 35.26%) were ruptured. The overall short-term (< 1week post-operation) patency rate was 93.6% (218/233) and long-term (>12month follow-up) patency was 89% (96/108). Of the 207 aneurysms, complete obliteration was achieved in 202 cases (98% aneurysm occlusion rate); 167 aneurysms (80%) were in the anterior circulation and 41 (20%) were in the posterior circulation. There was a total of 12 deaths (mortality rate 6%), 7 of whom presented with subarachnoid hemorrhage (aSAH). Post-operatively, 81.18% (165/203) achieved a good outcome (mRS 0-2) at the most-recent follow-up.

Conclusion: Despite the recent advances in endovascular technology, cerebral bypass remains a critical microsurgical technique for the modern cerebrovascular neurosurgeon that may be needed in treatment of rare, complex intracranial aneurysms that do not have endovascular solutions.

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Kiran Rajneesh, UCI	2009
Justin Dye, UCLA **	2010
Isaac Yang, UCSF **	2010
Terry Burns, Stanford**	2011
Gabriel Zada, USC	2011
Walavan Sivakumar, U. of Utah	2012
David Stidd, U. of Arizona	2012
Allyson Alexander, Stanford	2013
Anand Veeravagu, Stanford**	2013
Terry Burns, Stanford**	2014
Karam Moon, BNI	2014
Achal Achral, Stanford	2015
Jesse Skoch, Tucson	2015
Nicholas Au Yong, UCLA	2016
Priscilla Pang, OHSU	2016
Kevin Kwong-Hon Chow, Stanford	2017
Douglas Hardesty	2017
Allen Ho, MD Stanford	2018
Yevgeniy Freyvert, UCLA	2018
Arjun Pendharkar, Stanford	2019
Srinivas Chivukula, UCLA	2019
Jessica Eaton, U. of Washington	2021
Matthew Sun, UCLA	2021
Joshua Catapano, BNI	2022
Jacob Young, UCSF	2022

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Past Meetings of the Society

1. Biltmore Hotel, Santa Barbara, CA	Nov 25-26, 1955
2. Timberline Lodge, OR	Dec 9-11, 1956
3. Holiday Hotel, Reno, NV	Sept 29-Oct 1,1957
4. Del Monte Lodge, Pebble Beach, CA	Oct 19-22, 1959
5. La Valencia Hotel, La Jolla, CA	Sept 27-30, 1959
6. Del Monte Lodge, Pebble Beach, CA	Oct 23-26, 1960
7. Bayshore Inn, Vancouver, BC	Oct 29-Nov 1, 1961
8. Camelback Inn, Phoenix, AZ	Oct 28-31, 2962
9. El Mirador Hotel, Palm Springs, CA	Oct 20-23, 1963
10. Fairmont Hotel, San Francisco, CA	Oct 18-21, 1964
11. Olympic Hotel, Seattle, WA	Oct 3-6, 1965
12. Hotel Utah, Salt Lake City, UT	Nov 6-9, 1966
13. Kona Kai Club, San Diego, CA	Oct 15-18, 1967
14. Mauna Kea Beach Hotel, Kamuela, HI	Nov 16-19, 1968
15. Del Monte Lodge, Pebble Beach, CA	Oct 15-18, 1969
16. Bayshore Inn, Vancouver, BC	Oct 4-7, 1970
17. The Broadmoor, Colorado Springs, CO	Oct 31-Nov 3, 1971
18. The Skyline Country Club, Tucson, AZ	Oct 29-Nov 1, 1972
19. Airport Marina Hotel, Albuquerque, NM	Sept 16-19, 1973
20. Santa Barbara Biltmore Hotel, CA	Oct 27-30, 1974
21. Mauna Kea Beach Hotel, Kamuela, HI	Sept 28-Oct 1, 1975
22. Harrah's Hotel, Reno, NV	Sept 26-29, 1976
23. La Costa Resort Hotel, Carlsbad, CA	Sept 18-21, 1977
24. The Lodge, Pebble Beach, CA	Oct 8-11, 1978
25. Camelback, Inn, Scottsdale, AZ	Sept 23-26, 1979
26. Mauna Kea Beach Hotel, Kamuela, HI	Sept 21-24, 1980
27. The Empress Hotel, Victoria, BC	Sept 20-23, 1981
28. Jackson Lake Lodge, Jackson Hole, WY	Sept 12-15, 1982
29. Hotel del Coronado, Coronado, CA	Oct 2-5, 1983
30. The Broadmoor, Colorado Springs, CO	Sept 9-12, 1984
31. Silverado Country Club & Resort, Napa, CA	Sept 22-25, 1985
32. Maui Intercontinental, Wailea, Maui, HI	Sept 28-Oct1, 1986
33. Banff Springs Hotel, Banff, AB	Sept 6-9, 1987
34. Ritz-Carlton, Laguna Niguel, CA	Sept 11-14, 1988
35. The Lodge, Sun Valley, ID	Sept 10-13, 1989
36. Mauna Lani Bay Hotel, Kawaihae, HI	Sept 9-12, 1990
37. The Pointe, Phoenix, AZ	Sept 22-25, 1991
38. The Whistler, Whistler, BC	Sept 20-23, 1992
39. Mauna Lani Bay Hotel, Kawaihae, HI	Sept 19-22, 1993
40. Le Meridien Hotel, San Diego, CA	Sept 18-21, 1994

Past Meetings of the Society

...continued

41. Salishan Lodge, Gleneden Beach, OR	Sept 9-12, 1995
42. Manele Bay, Island of Lanai, HI	Sept 14-17, 1996
43. Ojai Valley Inn, Ojai, CA	Sept 20-23, 1997
44. Silverado Resort, Napa, CA	Sept 12-15, 1998
45. Coeur d'Alene Resort, Coeur d'Alene, ID	Sept 18-21, 1999
46. Mauna Lani Bay Hotel, Hawaii, HI	Sept 9-11, 2000
47. Ocean Pointe Resort, Victoria BC (Cancelled)	Sept 15-18, 2001
48. Delta Victoria Resort, Victoria, BC	Oct 12-15, 2002
49. Hapuna Beach Prince Hotel, Kamuela, HI	Sept 20-24, 2003
50. Rancho Bernardo Inn, San Diego, CA	Sept 11-14, 2003
51. Squaw Creek Resort, Lake Tahoe, CA	Sept 17-20, 2005
52. Semiahmoo Resort & Spa, Blaine, WA	Sept 16-19, 2006
53. Mauna Lani Bay Hotel, Kawaihe, HI	Sept 8-11, 2007
54. Hotel Captain Cook, Anchorage, AK	Aug 16-19, 2008
55. Sun River Resort, Bend, OR	Sept 11-14, 2009
56. Eldorado Hotel, Santa Fe, NM *In Memory of L. Philip Carter*	Oct. 8-11, 2010
57. Grand Hyatt Kauai Resort & Spa, Kauai, HI	Sept 10-13, 2011
58. The Broadmoor, Colorado Springs, CO	Sept 7-11, 2012
59. Ritz Carlton Half Moon Bary, Half Moon Bay, CA	Sept 15-18, 2013
60. The Lodge, Sun Valley, ID	Aug 16-19, 2014
61. Grand Hyatt Kauai Resort & Spa, Kauai, HI	Sept 10-13, 2015
62. Park Hyatt Aviara, Carlsbad, CA	Sept 9-12, 2016
63. Fairmont Bank Springs Hotel, Banff, Alberta, Canada	Sept 8-11, 2017
64. Fairmont Orchid, Kona, HI	Sept 14-17, 2018
65. Hyatt Regency at Gainey Ranch, Scottsdale, AZ	Nov 8-11, 2019
66. Virtual Annual Meeting (Covid-19 Pandemic)	July 25, 2020
And Special Virtual Scientific Meeting	Aug 29, 2020
67. Hyatt Tamaya, Santa Ana Pueblo, NM	Sept 10-13, 2021
68. Fairmont Orchid, Kohala Coast, HI	Sept 9-12, 2022

Future Meetings

70. Fairmont Grand Del Mar, San Diego, CA	Sept. 5-8, 2024
71. Coeur d'Alene Resort, Coeur d'Alene, ID	Sept. 11-14, 2025
72. Royal Sonesta Kauai Resort, Lihue, HI	Sept 24-27, 2026

Western Neurosurgical Society
Member Directory
and
Geographical Directory

Did you know -

The street now known as Cannery Row in Monterey was initially named Ocean View Avenue. Area native John Steinbeck published his book Cannery Row in 1945. There was close to a quarter of a million tons of sardines canned that year. The Cannery Row novel is set during the Great Depression and focuses on people on the margin of society. Ocean View Avenue was renamed after John Steinback's novel Cannery Row in 1958.

Please provide corrections and/or updates to the WNS Registration desk.

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Tacoma

W. Ben Blackett, M.D.

WEST VIRGINIA

Huntington

J. Paul Muizelaar, M.D.

GERMANY

Hanover

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