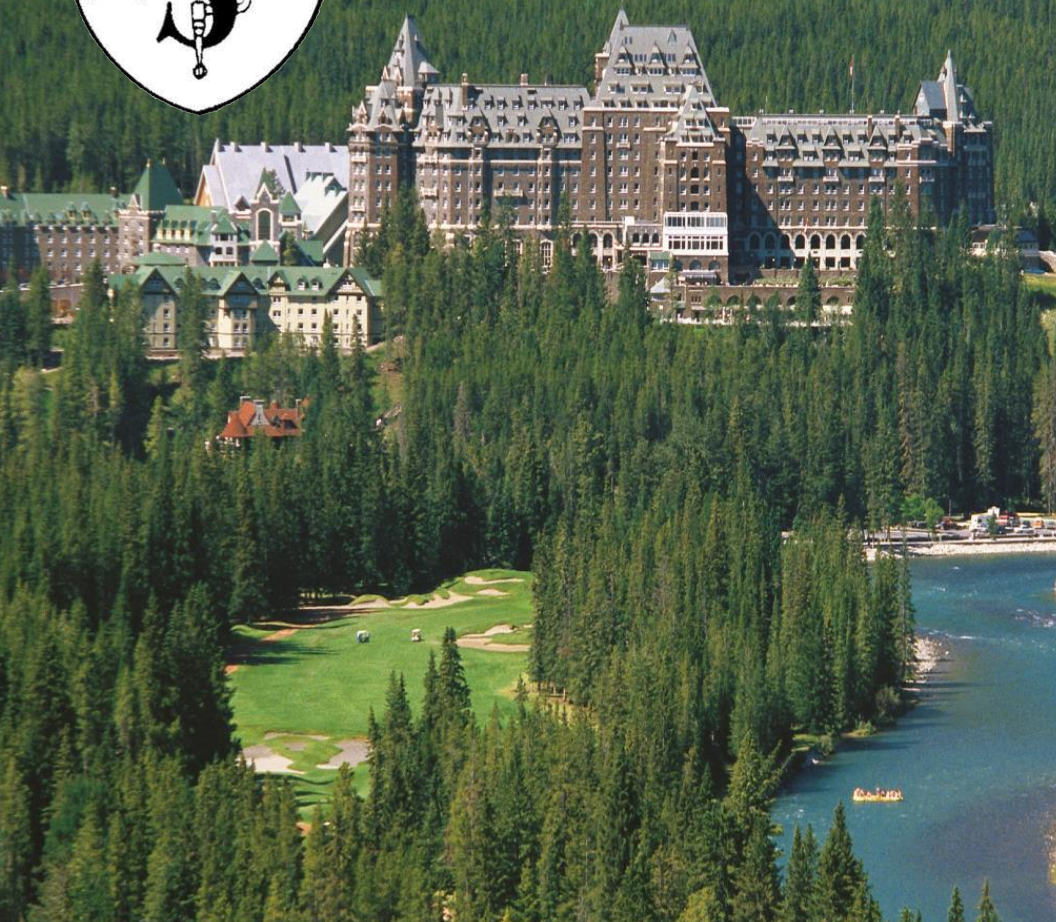




American
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Neurological
Surgeons

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WESTERN
NEUROSURGICAL
SOCIETY

63RD ANNUAL
MEETING

Fairmont Banff Springs | Program Booklet 2017
September 9-11, 2017 | Banff, AB, Canada

CALENDAR OF EVENTS

Friday, September 8th, 2017

12pm – 4pm	Executive Committee Meeting	Angus Room
12pm – 11pm	Exhibits/Setup	New Brunswick Room
2pm – 5:30pm	Registration	Curio Foyer
6pm – 9:30pm	Reception/Unique Taste of Canada	New Brunswick/Riverview Lounge

Saturday, September 9th, 2017

6:45am – 7:25am	Breakfast with Exhibitors	New Brunswick Room
6:30 - 12:00pm	Registration	Curio Foyer
7:30am – 9:00am	Scientific Session 1 -2	Alberta Room
8:30am – 10am	Spouses Breakfast	Upper Rundle Lounge
9am – 9:45am	General Interest Topic: Canadian Rockies	Alberta Room
9:45 – 10:15am	Coffee Break with Exhibitors	New Brunswick Room
10:15 – 11:00am	Special Lecture on Spine Healthcare Quality	Alberta Room
11:00am - Noon	Scientific Session 3	Alberta Room
Noon	Adjourn for day	
1:30pm - 5pm	Tennis	Tennis Courts
1pm – 5pm	Golf	Golf Course
2pm-4pm	Bowling ~ Ping Pong ~ Billiards	Bowling Alley on site
1:30 – 4pm	Bike Ride - Meet in Lobby	Meet in Lobby
5:30pm-6pm	Shuttle to Brewster's BBQ	Meet in Lobby for Shuttle
6pm/7pm	Reception/Dinner LOCAL NIGHT	Mountview Brewster's BBQ

Sunday, September 10th, 2017

6:30am – 8:00am	Business Meeting (Members Breakfast)	Ivor Petrak Room
6:30am –8:00 am	Breakfast w/Exhibitors (nonmembers)	New Brunswick
6:30 - 12:00pm	Registration	Curio Foyer
8 am – 9:45am	Scientific Session 4 – 5	Alberta Room
8:30 am – 10am	Spouses' Breakfast	Upper Rundle Lounge
9:45- 10:35	Ablin Lecture/Lucy Kalanithi, M.D.	Alberta Room
10:35am – 11:00am	Coffee Break with Exhibitors	New Brunswick
11am – 11:45am	Cloward Award Lecture/Volker Sonntag, M.D.	Alberta Room
11:45 – 12:30pm	Presidential Address	Alberta Room
12:30pm	Adjourn for the day	
1pm – 5pm	Golf	Golf course
1:30pm – 5pm	Tennis	Tennis Courts
1:30pm – 4:30pm	Horseback Riding	Meet in Lobby for bus
6:30pm – 11pm	Formal Reception /Black Tie Dinner/Dancing	Mt Stephen Hall /Alhambra

Monday, September 11th, 2017

6:45am – 7:30am	Breakfast with Exhibitors	New Brunswick Room
7:30am – 12pm	Registration	Curio Foyer
7:30am – 8:10am	Resident Award Presentations	Alberta Room
8:30am – 10am	Spouses Breakfast	Upper Rundle Lounge
8:10am-8:50am	Scientific Session 6	Alberta Room
8:50am-9:35am	Special Lecture on Healthcare Reform	Alberta Room
9:35am-9:50am	Coffee Break with Exhibitors	New Brunswick Room
9:50am-11:50pm	Scientific Session 7 – 8	Alberta Room
11:50pm-12:25pm	Special Lecture on Neurosurgery Career	Alberta Room

12:25

Meeting Adjourns

SEE YOU IN HAWAII!

Western Neurosurgical Society 63rd Annual Meeting

2017 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:

Objective 1: Recognize overall competence in the surgical care of intracranial pathology

Objective 2: Review overall competence in the surgical care of spinal disorders

Objective 3: Recognize the challenges facing Neurosurgeons regarding residency training competency, fellowship training and competency, and maintenance of certification.

Objective 4: Discuss overall competence in neuro critical care of neurosurgery patients.

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**The Western Neurosurgical Society would like to thank
Michi Wohns Carlson
2017 Exhibitor Coordinator**

2017 Officers & Committees

EXECUTIVE COMMITTEE

Charles Nussbaum, MD, President

Martin Weinand, MD, President-Elect

Linda M. Liau, MD, PhD, MBA, Past President

Odette Harris, MD, MPH, Vice President

Marc Vanefsky, MD, Secretary-Treasurer

Moustapha Abou-Samra, MD, Historian

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Deborah Henry

Gordon Li

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Adair Prall

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Gary Goplen

Charles Nussbaum

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Richard Chua

Christopher Taylor

Patrick Wade

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Linda Liau, Chair

Gary Steinberg

Jeffery Rush

Richard Wohns

LONG-RANGE PLANNING COMMITTEE

Linda Liau, Chair

SITE SELECTION COMMITTEE

David Pitkethly, Chair

Mark Belza

Deborah Henry

Charles Nussbaum

BY-LAWS COMMITTEE

Thomas Scully, Chair

Debbie Henry

Laura Snyder

AWARDS COMMITTEE

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Austin Colohan

Larry Shuer

Richard Wohns

COMMUNICATIONS/WEBSITE

Randy Smith, Chair

Moustapha Abou-Samra

Gregory Gerras

Ciara Harraher

Marco Lee

Marvin Bergsneider

MEMBERSHIP COMMITTEE

Marco Lee, Chair

Melanie Hayden-Gephart

Gary Goplen

Frederick Edelman

Fred Williams

Laura Snyder

EXHIBITORS

The Western Neurosurgical Society would like to thank the following exhibitors for their generous support in 2017.

GOLD SUPPORT

Medtronic Spine

www.medtronic.com/for-healthcare-professionals/products-therapies/spinal/

SILVER SUPPORT

Varian Medical Systems

<https://www.varian.com/>

EXHIBITORS 2017

*The Western Neurosurgical Society would like to thank
the following exhibitors for their support in 2017*

BK Ultrasound <http://bkultrasound.com/>

BrainLab <http://www.brainlab.com>

Codman <https://www.depuyshnthes.com/hcp/codman-neuro>

DePuy Synthes <http://www.depuyshnthes.com/>

Globus Medical <http://www.globusmedical.com/>

KLS Martin <http://klsmartinnorthamerica.com>

Monteris Medical <http://www.monteris.com>

NICO Neuro <http://www.niconeuro.com/>

Samsung Neurologica <http://www.neurologica.com/>

Sophysa USA, Inc <http://www.sophysa.com/>

Stryker <http://www.stryker.com>

Sutter Medical USA <http://www.sutter-usa.com/>

Synaptive Medical <http://synaptivemedical.com>

Zimmer Biomet <http://www.zimmerbiomet.com>

Educational Grant

Arbor Pharmaceutical <http://www.arborpharma.com>

2017 ATTENDEES

NAME	STATUS	SPONSOR
Samy Abdou	Member	
Moustapha Abou-Samra	Member	
Mark Belza	Member	
Sharon Ben-Haim	Member Candidate	
Blake Berman	Member Candidate	
Marvin Bergsneider	Member	
Ben Blackett	Member	
John Bonner	Member	
Harsimran Brara	Member Candidate	Dr. Bergsneider
Neil Brown	Member	
Joseph C T Chen	Member	
Srinivas Chivukula	Resident	
Kwong-Hon (Kevin) Chow	Resident Award Recipient	
Richard Chua	Member	
Austin Colohan	Member	
J. Stuart Crutchfield	Guest	Dr. Vanefsky
Justin Dye	Member Candidate	Dr. Bergsneider
Michael Edwards	Member	
Allen Efron	Member	
J. Paul Elliot	Member	
William Ganz	Member	
Gregory Gerras	Member	
Samer Ghostine	Guest	Dr. Abou-Samra, Linskey & Colohan
Gary Goplen	Member	
Mark Hamilton	Member	
Douglas Hardesty	Resident Award Recipient	
Ciara Harraher	Member	
Odette Harris	Member	
Melanie Hayden-Gephart	Provisional Member	
Deborah C. Henry	Member	
Terrance Holekamp	Guest	Dr. Nussbaum
Christopher Honey	Member	
Hector James	Member	
Stephen D. Johnson	Member	
Lucy Kalanithi	Ablin Lecturer	
George Koenig	Member	
U. Kumar Kakarla	Member Candidate	
Rod Lamond	Member	
Aleksandyr Lavery	Member	
Marco Lee	Member	
Kim Lefevre	Guest	Dr. Goplen
Michael Lemole	Member	
Gordon Li	Member	
Mark Linskey	Member	
Andrew Little	Member	
John Loeser	Member	
Mary Elizabeth MacRae	Member	
Matthew McGirt	Speaker	

John McVicker	Member	
Luke Macyszyn	Member Candidate	Dr.Bergsneider
Mark Mahan	Member Candidate	
Neil Martin	Member	
Zaman Mirzadeh	Member Candidate	
Alim Mitha	Member Candidate	
David Morgan	Member	
Jay Morgan	Member	
Praveen Mummaneni	Member	
David Newell	Member	
Jack Nisbit	Special Lecturer	
Charles Nussbaum	Member	
Katie Orrico	Speaker	
Julio Padilla	Guest	Dr. Goplen, Hamilton
Kimberly Page	Member	
David Pitkethly	Member	
Adair Prall	Member	
Donald Prolo	Member	
Richard Rapport	Member	
Marshal Rosario	Member	
Jeffrey Rush	Member	
Marc Schwartz	Member	
Thomas Scully	Member	
Laligam Sekhar	Member Candidate	
Peter Shin	Member	
Lawrence Shuer	Member	
Javed Siddiqi	Member	
John Slater	Member	
Randall Smith	Member	
Laura Snyder	Member	
Volker Sonntag	Cloward Award	
Tim Steege	Member	
Gary Steinberg	Member	
Suzanne Tharin	Member Candidate	
Philip Theodosopoulos	Member Candidate	
Jay Turner	Member Candidate	
Marc Vanefsky	Member	
Anand Veeravagu	Member Candidate	
Amir Vokshoor	Member	
Patrick Wade	Member	
Joseph Walker	Member	
John Wanebo	Member Candidate	
Martin Weinand	Member	
David Westra	Member Candidate	
Richard Wohns	Member	
Linda Xu	Resident	
Howard Yonas	Member	

CONTINUING MEDICAL EDUCATION ACCREDITATION

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. The AANS designates this live activity for a maximum of 12.00 AMA PRA Category 1 Credits™. Physicians should claim only the credit commensurate with the extent of their participation in the activity.

Disclaimer

The material presented at the 63rd annual meeting of the Western Neurosurgical Society has been made available by the WNS 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 WNS and jointly provided by the AANS, or its Committees, Commissions, or Affiliates. Neither the AANS nor the WNS makes any statements, representations or warranties (whether written or oral) regarding the Food and Drug Administration (FDA) status of any product used or referred to in conjunction with any course, seminar or other presentation being made available as part of the annual 60th meeting of the Western Neurosurgical Society. 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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The AANS controls the content and production of this CME activity and attempts to ensure the presentation of balanced, objective information. In accordance with the Standards for Commercial Support established by the Accreditation Council for Continuing Medical Education (ACCME), speakers, paper presenters/authors and staff (and the significant others of those mentioned) are asked to disclose any relationship they or their co-authors have with commercial interests which may be related to the content of their lecture. The ACCME defines "relevant financial relationships" as financial relationships in any amount occurring within the past 12 months that create a conflict of interest.

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.

NAME	TYPE OF RELATIONSHIP
Christopher Honey	Grant, Consultant fee, Industry Grant
Andrew Little	Grant, Industry Support, Shareholder, Fiduciary Position
Gordon Li	Grant, Consultant fee,
Matthew MacDougall	Consultant Fee
Matthew McGirt	Consultant Fee, other financial or material support
Praveen Mummaneni	Grant, Consultant fee, Stock or Shareholder, Honorarium, employee, Other
Richard Rapport	Stock or Shareholder
Marc Schwartz	Industry support, consultant fee
Thomas Scully	Consultant Fee, Stock or Shareholder, honorarium, Fiduciary position
Laligam Sekhar	University grant, stock or shareholder
Gary Steinberg	University Grant, Consultant Fee, Stock/Shareholder
Jay Turner	University Grant/research support
Marc Vanefsky	
Anand Veeravagu	Consultant fee, Honorarium
John Wanebo	University grant/research support, consultant fee, Speaker's Bureau, Employee

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:

Moustapha Abou-Samra, MD	Luke Macyszyn, MD
Marvin Bergsneider, MD	Mark Mahan, MD
Blake Berman, MD	Zaman Mirzadeh, MD
Srinivas Chivukula, MD	Alim Mitha, MD
Justin Dye, DO	Jack Nisbit
William Ganz, MD	Charles Nussbaum MD *
Douglas Hardesty, MD	Katie Orrico
Ciara Harraher, MD	Peter Shin, MD
Odetta Harris, MD	Laura Snyder, MD
Melanie Hayden Gephart, MD	Volker Sonntag, MD
Hector James, MD	Suzanne Tharin, MD
Udaya Kumar Kakarla, MD	Philip Theodosopoulos, MD
Lucy Kalanithi, MD	Claudia Martin, MD
Kevin Kwong-hon Chow, MD	Amir Vokshoor, MD
Marco Lee, MD	Martin Weinand *
Mark Linskey, MD	David Westra, MD
John Loeser, MD	Marc Vanefsky, MD

*educational content planner of this meeting

Dr. 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.

ABLIN LECTURER



Lucy Kalanithi, M.D., FACP

Lucy Kalanithi, MD, FACP is the widow of Dr. Paul Kalanithi, neurosurgeon and author of the #1 New York Times bestselling memoir *When Breath Becomes Air*, a meditation on mortality and meaning that spent 22 weeks at #1 on the New York Times bestseller list in 2016.

A Clinical Assistant Professor of Medicine at the Stanford School of Medicine, Dr. Kalanithi completed her medical degree at Yale, where she was inducted into the Alpha Omega Alpha national medical honor society, her residency at the University of California-San Francisco, and postdoctoral fellowship training in healthcare delivery innovation at Stanford's Clinical Excellence Research Center. Dr. Kalanithi has special interests in healthcare value, meaning in medicine, and end-of-life care. She wrote the epilogue to *When Breath Becomes Air*, has spoken at TEDMED, and appeared in *The New York Times*, NPR, PBS Newshour, *The Kelly File*, and Yahoo News with Katie Couric. She lives in the San Francisco Bay Area with her daughter, Elizabeth Acadia.

"When Breath Becomes Air - A Conversation with Lucy Kalanithi"

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 Piepgas, MD**, Professor of Neurosurgery, Mayo Clinic.
"Frontier Surgery: Lessons for Today from Beaumont and St. Martin"
- 2016 Larry R. Squire, Ph.D.** *The Legacy of Patient H.M. – Cognitive Neuroscience of Human Memory*

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."

2017 CLOWARD AWARD RECIPIENT



Volker K.H. Sonntag, M.D.

Vice Chairman Emeritus, Barrow
Neurological Institute

Born in West Prussia, Volker Sonntag, MD spent his toddler years in a West German refugee camp and immigrating to America in 1957. Dr. Sonntag worked his way through medical school and was in the first class to graduate from the University of Arizona Medical School in 1971.

Dr. Sonntag attended Arizona State University in Tempe, AZ., from 1963 to 1967, receiving a Bachelor of Arts degree in Chemistry, *summa cum laude*. From 1967 to 1971, he attended the University of Arizona School of Medicine. He served as President of his graduating class and completed his internship there in 1972. In 1972, Dr. Sonntag moved to Tufts-New

England Medical Center Hospital in Boston, MA, where he trained as one of the first residents under Bennett M. Stein, M.D., Professor and Chairman, Department of Neurosurgery. He completed his residency in 1977.

Since joining the Barrow Neurological Institute (BNI) in 1983, he has served as Vice-Chairman of the Division of Neurological Surgery and Chairman of the Spine Section from 1984 to 2010, Director of the Spine Fellowship Program from 1988 to 2010, and as Director of the Residency Program from 1995 to 2010. In 2000, he assumed the endowed Alumni Spine Chair at the BNI.

For the past 30 years, Dr. Sonntag has been a leader in neurosurgery as a director on the American Board of Neurological Surgery 1998-2004, member of the ACGME Residency Review Committee (RRC) 2005-2011, Vice President of the American Association of Neurological Surgeons in 2001, and as a member of the AANS Professional Conduct Committee 2008-2011. He was president of the North American Spine Society in 2000 and American Academy of Neurological Surgery in 2004. In 2002, Dr. Sonntag was named the Honored Guest of the Congress of Neurological Surgeons, the highest honor paid to a neurosurgeon by his peers.

Dr. Sonntag made significant contributions to the treatment and understanding of spinal disorders. He has co-edited five major books, made more than 980 presentations around the world, and written more than 110 textbook chapters and 480 papers, and is an editor on 10 neurosurgical journals. He is consistently recognized as one of the Best Doctors in America.

Dr. Sonntag retired from practicing neurosurgery in January 2010 but remains at the BNI as Vice-Chairman Emeritus.

2910 North 3rd Avenue
Phoenix, AZ 85013
(602) 406-3458

His topic for our meeting: The Journey of Spinal Neurosurgery in the United States

CLOWARD AWARD

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 Stanford University

"Stepping-Out of the OR: A Surgeon's Foray into Entrepreneurship"

2014 Andres M. Lozano, MD, Professor of Neurosurgery, University of Toronto

"Taming Dysfunctional Brain Circuits"

2015 Edward Oldfield, MD, Professor of 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*

Saturday September 9, 2017

6:45-7:25

Breakfast with Exhibitors

7:25-7:30

Welcome - Charles Nussbaum

7:30-8:30

Scientific Session (1) : Vascular Neurosurgery (8 min talk, 4 min discussion)

Moderators: Marc Vanefsky and Gordon Li

- Mesenchymal stem cells inhibit saccular aneurysm pathogenesis in a rabbit model, Alim Mitha (candidate member)
- Brainstem arteriovenous malformations: lesion characteristics and treatment outcomes, Gary Steinberg (member)
- Hemi-laryngopharyngeal spasm (HELPS) syndrome: The discovery and cure of a new neurological condition, Christopher Honey (member)
- Basilar tip aneurysms: endovascular and microsurgical treatment, outcomes and costs, Laligam Sekhar (member)
- Pediatric trigeminal neuralgia: results with early microvascular decompression, Mark Linskey (member)

8:30-9:00

Scientific Session (2) : Vestibular Schwannoma (10 min talk, 5 min discussion)

Moderators: Marc Vanefsky and Gordon Li

- Hybrid treatment strategies for large vestibular schwannomas, Philip Theodosopoulos (candidate member)
- Patterns of facial nerve injury in translabyrinthine resection of acoustic neuromas, Marc Schwartz (member)

General Interest Topic: Canadian Rockies

9:00-9:05

Introduction of Jack Nisbet by William Ganz

9:05-9:35

A farther road: David Thompson's search for trails through the Canadian Rockies, Jack Nisbet, Naturalist and Author

9:35-9:45

Discussion with Jack Nisbet

9:45-10:15

Break with Exhibitors

Special Lecture on Spine Healthcare Quality

10:15-10:20

Introduction of Matthew McGirt by Andrew Little

10:20-10:50

Outcomes data in the healthcare reform era: why it matters, Matthew McGirt

10:50-11:00

Discussion with Matthew McGirt

11:00-Noon

Scientific Session (3): Spinal Instrumentation and Biologics (10 min talk, 5 min discussion)

Moderators: Laura Snyder and Odette Harris

- Retrospective analysis of mesenchymal stem cell allograft in integrated interbody cervical devices for one or more level ACDF procedures, Amir Vokshoor, MD (member)
- Biological adjuncts to achieving a solid lumbar bony fusion, David Westra, MD (candidate member)
- Anchored cervical cage use in cervical spine trauma, John Wanebo (candidate member)
- Treating cervical and lumbar radiculopathies using irrigated single instrumentation port endoscopic visualization, Peter Shin (member)

Noon

Adjourn, afternoon activities

---- **Local Night** ---- **Mount View BBQ**

Sunday September 10, 2017

6:30-8:00 **Member Business Meeting & Guest Breakfast**

8:00-9:00 **Scientific Session (4): Highlights of Translational Research and Emerging Therapies** (10 min talk, 5 min discussion)

Moderators: Marvin Bergsneider and Marco Lee

- A neurosurgical future for type 2 diabetes treatment: hypothalamic tanycytes and glucose homeostasis, Zaman Mirzadeh (candidate member)
- Toward a cure for paralysis: microRNA controls over corticospinal motor neuron development, Suzanne Tharin (candidate member)
- Liquid biopsy of limited use for spinal ependymoma due to anatomic sequestration, Melanie Hayden Gephart (member)
- Obesity is associated with inferior patient reported outcomes following surgery for degenerative lumbar spondylolisthesis: an analysis of the quality outcomes database, Praveen Mummaneni (member)

9:00-9:45 **Scientific Session (5): Brain Tumors** (10 min talk, 5 min discussion)

Moderators: Mark Linskey and William Ganz

- En bloc pseudocapsular resection of endocrine active pituitary adenoma improves surgical outcomes, Srinivas Chivukula (resident presenter)
- When is it safe to restart CPAP for obstructive sleep apnea following transsphenoidal surgery: an institutional experience, Andrew Little (member)
- Phase II study of biweekly temozolomide plus bevacizumab for adult patients with recurrent glioblastoma, Thomas Scully (member)

Ablin Lecture

9:45-9:50 Introduction by Charles Nussbaum

9:50 to 10:35 When Breath Becomes Air – A Conversation with Lucy Kalanithi, facilitated by Gordon Li

10:35-11:00 **Break with Exhibitors**

Cloward Award Lecture

11:00-11:05 Introduction by Martin Weinand

11:05-11:45 The journey of spinal neurosurgery in the United States, Volker Sonntag

Presidential Address

11:45-11:50	Introduction by Randy Smith
11:50- 12:30	Spine center of excellence program at Virginia Mason: lessons learned, Charles Nussbaum
12:30	Adjourn , afternoon activities

----Formal Night----

Canada and 911, a Western Neurosurgery Society perspective, Moustapha Abou-Samra, (Member, Historian)

Monday September 11, 2017

6:45-7:30 **Breakfast with the Exhibitors**

7:30-8:10 **Resident Award Presentations** (15 min talk, 5 min discussion)

Moderators: Gordon Li and Andrew Little

Basic Science Award

B7-H3 chimeric antigen receptor modified T cells show potent anti-tumor activity in a preclinical model of glioblastoma, Kevin Kwong-Hon Chow

Clinical Science Award

Emergency department utilization and hospital readmission within 30 days after 7,294 cranial neurosurgery procedures at a tertiary neuroscience center, Douglas Hardesty

8:10-8:50 **Scientific Session (6): Pain and Function** (15 min talk, 5 min discussion)

Moderator: Moustapha Abou-Samra

- Mini-renaissance in peripheral nerve surgery, Mark Mahan (candidate member)
- Neurosurgeons who help develop pain control protocols, John Loeser (member)

Special Lecture on Healthcare Reform

8:50-8:55 Introduction of Katie Orrico, Thomas Scully

8:55-9:25 The Affordable Care Act and the 7-year itch, Katie Orrico

9:25-9:35 Discussion with Katie Orrico

9:35-9:50 **Break with Exhibitors**

9:50-10:50 **Scientific Session (7): Spinal Deformity Surgery** (10 min talk, 5 min discussion)

Moderators: Charles Nussbaum and Laura Snyder

- Elevated fall risk in patients with adult spinal deformity, Jay Turner (candidate member)
- Controversies in spine deformity surgery, Kumar Kakarla (candidate member)
- Scoliosis surgery: safety, value, and efficacy, Anand Veeravagu (candidate member)
- Current concepts and trends in spinal deformity surgery, Luke Macyszyn (provisional member)

10:50-11:50 **Scientific Session (8): High Yield Abstracts** (15 min talk, 5 min discussion)

Moderator: Martin Weinand and Ciara Harraher

- Value of neurosurgery in Sub-Saharan Africa: neurosurgical treatment and outpatient outcomes in Uganda, Linda Xu (resident presenter)
- Anatomical and surgical behavior of metastatic calvarial tumors with intracranial extension, Blake Berman (candidate member)
- Pore and glymphatics theories and shunt malfunction: report of a case and theory discussion, Hector James (member)

Special Lecture on Neurosurgery Career Challenges

11:50-11:55 Introduction of Richard Rapport by Andrew Little

11:55-12:15 Late career obligations and happiness, Richard Rapport (member)

12:15-12:25 Discussion with Richard Rapport

12:25 **Program End**

See you in Hawaii in 2018.

GENERAL INTEREST TOPIC: CANADIAN ROCKIES



Jack Nisbet, Naturalist and Author

Jack Nisbet is a Spokane-based writer who explores the intersection of human and natural history. *Sources of the River*, his biography of David Thompson, won the Murray Morgan History Prize in 1995. Since then Nisbet has participated in several documentary films and museum exhibits focused on Thompson's western journeys; these gave rise to his book *The Mapmaker's Eye: David Thompson on the Columbia Plateau*.

Nisbet's most recent title is *Ancient Places:*

People and Landscape in the Emerging Northwest. For more information, visit www.jacknisbet.com

SPECIAL LECTURE on SPINE HEALTHCARE QUALITY



Dr. McGirt is a board certified neurosurgeon practicing in Charlotte, North Carolina. At Carolina Neurosurgery & Spine Associates (CNSA), he specializes in both minimally invasive and complex spinal surgery and serves as Director of Value Based Care & Quality Data Programs. He is married with four children.

Dr. McGirt received his undergraduate and medical degrees from Duke University. He completed his neurosurgery residency and spine fellowship at Johns Hopkins under the mentorship of Ziya Gokaslan. Dr. McGirt was director of patient safety and quality at Vanderbilt University Neurosurgery and founder of the Vanderbilt spinal column and surgical outcomes laboratory prior to returning to his hometown to join CNSA.

As vice director of the national neurosurgery quality outcomes data base (N2QOD), he helped launch and grow North America's largest spinal outcomes registry. Dr. McGirt has published 300 peer reviewed manuscripts and continues to publish on value and quality measurement in neurosurgical care.

RESIDENT AWARD

Basic Science Award 2017



Kwong-Hon (Kevin) Chow, MD

B7-H3 chimeric antigen modified T cells show potent anti-tumor activity in a preclinical model of glioblastoma

Congratulations Dr. Kwong-Hon (Kevin) Chow for winning the Basic Science award for this year's WNS. Kevin (as he goes by) was born and raised in and around Houston, Texas. He is a first generation American, his father was born in southern China and his mother is a courageous refugee from Vietnam following the war. Kevin's family began in

Texas in the restaurant business, his grandfather and father opened many traditional Chinese (Cantonese) restaurants.

Kevin found the natural sciences in school fascinating and was encouraged to go into medicine by his grandfather. Incidentally, Kevin has an uncle in Texas who continues to practice in neurosurgery. Kevin won a scholarship to attend Wash. U. where he studied biology and cognitive neuroscience. Kevin returned to Texas after under graduate school where he studied at the Medical Scientist Training Program in Baylor. Kevin earned his M.D./Ph.D. in 2013/2012 while attending Baylor. His dissertation was on T cell immunotherapy for Glioblastoma with Dr. Stephen Gottschalk. During medical school, Kevin had an opportunity to scrub in on a sphenoid wing meningioma that was performed by Dr. DeMonte at MD Anderson, he became cemented in neurosurgery. Kevin ultimately matched at Stanford for residency where he continues his inquisitive nature into Glioma immunotherapy.

Kevin has a younger brother studying family medicine in Colorado and a much younger brother in middle school in Texas. Kevin is quite athletic and when he has time, he participates in triathlons, the latest in San Francisco, the "Escape from Alcatraz" race. Kevin brought his mother and grandfather (who encouraged him to enter medicine) to the Western this year. Kevin is certainly on his way to prosperous, academic career.

Submitted by Greg Gerras, MD – WNS Member

CLINICAL SCIENCE

Resident Award 2017



Douglas Hardesty, MD

Dr. Hardesty is a Chief Resident in neurosurgery at the Barrow Neurological Institute. Dr. Hardesty graduated from Earlham College with a B.A. in Chemistry in 2007, and subsequently obtained his M.D. from the University of Pennsylvania School of Medicine in 2011 before starting residency at the BNI. He completed in 2016-2017 an enrolled clinical fellowship at The Ohio State University in endoscopic and minimally invasive skull base surgery. He is a member of the Phi Beta Kappa and Alpha Omega Alpha honor societies.

Dr. Hardesty has authored or co-authored 19 currently published peer-reviewed manuscripts, 12 book chapters, and 39 meeting abstracts, podium talks, meeting posters, and Grand Rounds presentations. He is an Associate Editor for BMC Cancer and an elected member of the AANS Young Neurosurgeons Committee.

Dr. Hardesty's research interests include the molecular pathogenesis of craniopharyngioma, as well as quality improvement and resource utilization in cranial neurosurgery. He and his wife Shaina, an author, reside in Phoenix, Arizona, with their genetically ambiguous shelter dog.

-Ciara Harraher, MD, WNS Member

His topic for our meeting: **Emergency department utilization and hospital readmission within 30 days after 7,294 cranial neurosurgery procedures at a tertiary neuroscience center**

SPECIAL LECTURE on HEALTHCARE REFORM



Katie O. Orrico, Esq., is the director of the Washington Office of the American Association of Neurological Surgeons (AANS) & 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 advocacy firm, where she represented the AANS and CNS, among other health care clients. While working for CLP Associates, Katie pursued her law degree at night, and in 1991 earned her Juris Doctor degree from the George Mason

University Antonin Scalia Law School. In 1997, she was selected to become the director of the AANS and CNS Washington Office, upon the establishment of a full-time office. She is licensed to practice law in the Commonwealth of Virginia.

In her capacity as the AANS/CNS Washington Rep., Ms. Orrico works closely with other medical societies on several legislative coalitions. She is one of the founding members of the Alliance of Specialty Medicine, which represents 14 national medical specialty societies with over 100,000 physician members. The Alliance was formed in 2001 to give the specialty medicine a collective voice in Washington, DC and Ms. Orrico is a member of the Alliance's leadership. She is also the vice-chair of the Health Coalition on Liability and Access, a coalition dedicated to enacting federal medical liability reform legislation. In 2008, Ms. Orrico was invited to serve as a founding member of the steering committee of the Partnership to Improve Patient Care, an initiative whose mission is to raise awareness about the value of well-designed comparative effectiveness research. In 2011, Ms. Orrico joined with her colleagues in anesthesiology and obstetrics and gynecology, in organizing a coalition of physician organizations aimed at repealing the Independent Payment Advisory Board, or IPAB. In 2012, Ms. Orrico helped establish the Physician Clinical Registry Coalition, which focuses on legislative and regulatory policy issues affecting clinical data registries. Most recently, in 2015, she was invited to participate on the AMA-led MACRA Task Force and MIPS Workgroup.

Ms. Orrico also serves as the AANS/CNS staff liaison to a number of health care organizations, including: the Ad Hoc Group for Medical Research, American College of Surgeons/Surgical Coalition, American Medical Association (AMA), Coalition of Patient Centered Imaging, Council of Medical Specialty Societies, GME Advocacy Coalition and the Medical Device Coalition.

She is frequently invited to speak on such topics as Medicare reimbursement, quality improvement, medical liability reform, graduate medical education and the Emergency Medical Treatment and Labor Act (EMTALA). Ms. Orrico is also a regular contributor to several neurosurgical publications, and is a member of the editorial boards of the AANS Neurosurgeon, Congress Quarterly and Neurosurgery Blog.

In recognition of her contributions to organized neurosurgery, in 2003, Ms. Orrico was awarded the CNS' Distinguished Service Award and in 2010 she received the AANS' Distinguished Service Award. In 2012, the American Society of Pediatric Neurosurgery bestowed on Ms. Orrico an honorary membership, which is reserved for those individuals for their importance to the development of the specialty of Pediatric Neurosurgery. Most recently, in 2016, the AANS/CNS Council of State Neurosurgical Societies (CSNS) bestowed upon her the Leibrock Lifetime Achievement Award, given to recognize individuals who have dedicated themselves to the grass roots effort that is represented by the CSNS. Later that same year, Ms. Orrico received the AMA's Medical Executive Lifetime Achievement Award. The award honors a medical association executive who has contributed substantially to the goals and ideals of the medical profession.

Ms. Orrico is a member of a number of professional organizations, including the American Health Lawyers Association & Virginia Bar Association.

SPECIAL LECTURE on NEUROSURGERY CAREER CHALLENGES



Richard Rapport is a UW clinical professor of neurological surgery and attending physician on the wards and in the neuro ICU at Harborview Medical Center. His literary essays are seen widely in various forms. Several of his nearly forty published essays have been nominated for the Pushcart Prize, and one was noted in Best American Essays, 1998. "To Die of Having Lived," an essay concerned with problems at the end of life, appeared in the Spring 2010 American Scholar. He has published two books of non-fiction, *Physician: The Life of Paul Beeson* (Barricade Books, 2001) and *Nerve Endings: The Discovery of the Synapse* (WW Norton, 2005). Both were nominated for the Washington State

Book Award, and the latter was nominated for the European Science writing award, The Aventis Prize. A third book is in production.

In addition, he has been the invited lecturer at more than a dozen medical schools, including Grand Rounds at the University of Washington in both medicine and neurological surgery, the Annual History of Medicine Lecture at the Mayo Clinic, The Paul Beeson Lecture at Harvard's Countway Library, twice given the Introduction to Clinical Medicine address at UW, and in 2007 he delivered the commencement address for the Northwestern University Feinberg School of Medicine. Dr. Rapport has been a visiting professor at the University of Malaya for protracted periods, and once at the University of Hue in Vietnam.

Abstracts – Saturday: Mitha, Steinberg, Honey, Sehkar, Linskey, Theodosopoulos, Schwartz, Vokshoor, Westra, Wanebo, Shin

1. Mesenchymal Stem Cells Inhibit Saccular Aneurysm Pathogenesis in a Rabbit Model

Presenting Author Name, Degree, and Affiliation: **Alim P. Mitha, MD SM FRCSC**
University of Calgary
Co-Author Names and Degrees: Michael Avery, MD, Arin Sen, PhD

INTRODUCTION

Intracranial aneurysms have a prevalence of 2-4% in the population. Although treatment modalities are effective, disrupting aneurysm formation would potentially avoid the need for invasive treatments. Current research implicates inflammation as a primary event in aneurysm formation. Inhibition of aneurysm pathogenesis, therefore, would require blunting of the inflammatory cascade. Mesenchymal stem cells (MSCs) are readily available and have been studied as potential treatments for many diseases associated with inflammation, although no studies have examined their potential role in aneurysm pathogenesis. We hypothesize that injecting MSCs intravenously will minimize the formation of aneurysms in a saccular aneurysm model.

METHODS

Twenty New Zealand White Rabbits were randomly assigned to either control or intervention groups. All rabbits underwent right common carotid artery saccular aneurysm creation using elastase. At both the time of surgery and 14 days post-operatively, intervention group rabbits received an IV injection of 5×10^6 MSCs in 2mL saline, while control group rabbits received 2mL of vehicle. On day 28, the right femoral artery was cannulated in all rabbits and digital subtraction angiography performed. Aneurysm dimensions were calculated and compared between groups. Additional studies were performed to determine the location and mechanism by which the MSCs function.

RESULTS

All rabbits tolerated the surgical procedures well with no peri-operative complications, and every procedure resulted in aneurysm formation. Mean volume of right common carotid saccular aneurysms in the control and intervention groups were 22mm³ and 14mm³, respectively, which was not statistically different. Levene's test demonstrated inequality of variances, implying that there was significantly less variability in the volume of MSC-treated aneurysms compared to controls ($p=0.01$).

CONCLUSIONS

This is the first study investigating the ability of MSCs to inhibit the formation of saccular aneurysms. The observed effects may be secondary to MSC-induced inhibition of the initial inflammatory cascade of aneurysm pathogenesis.

2. Brainstem arteriovenous malformations: lesion characteristics and treatment outcomes

Presenting Author Name, Degree, and Affiliation: **Gary K. Steinberg, MD, PhD**, Department of Neurosurgery, Stanford University School of Medicine, Stanford, California

Co-Author Names and Degrees: Venkatesh S. Madhugiri, MCh, Mario K. C. Teo, FRCS, Joli Vavao, ACNP, CNRN, Teresa Bell-Stephens, BSN, CNRN

INTRODUCTION

Brainstem arteriovenous malformations (AVMs) are rare lesions that are difficult to diagnose and treat. They are often more aggressive in their behavior when compared with their supratentorial counterparts. The consequence of a brainstem hemorrhage is often devastating, and many patients are in poor neurological status at presentation. The authors examine the factors associated with angiographically confirmed cure and those affecting management outcomes for these complex lesions.

METHODS

This was a retrospective analysis of data gathered from the prospectively maintained Stanford AVM database. Lesions were grouped based on their location in the brainstem (medulla, pons, or midbrain) and the quadrant they occupied. Angiographic cure was dichotomized as completely obliterated or not, and functional outcomes was dichotomized as either independent or not independent at last follow-up.

RESULTS

Over a 23 year period, 39 lesions were treated. Of these, 3 were located in the medulla, 14 in the pons, and 22 in the midbrain. At presentation, 92% of the patients had hemorrhage, and only 43.6% were functionally independent. Surgery resulted in the best radiographic cure rates, with a morbidity rate of 12.5%. In all, 53% of patients either improved or remained stable after surgery. Absence of residual nidus and female sex correlated with better outcomes.

CONCLUSIONS

Brainstem AVMs usually present with hemorrhage. Surgery offers the best chance of cure, either in isolation or in combination with other modalities as appropriate.

3. Hemi-laryngopharyngeal spasm (HELPS) syndrome: The discovery and cure of a new neurosurgical condition

Presenting Author Name, Degree, and Affiliation: **Christopher Honey, MD, DPhil, FRCS**
Professor of Surgery (Neurosurgery) University of British Columbia

Co-Author Names and Degrees: Dr. Murray Morrison, MD, FRCS Professor of Surgery (Otolaryngology) University of British Columbia

INTRODUCTION

The first case of hemi-laryngopharyngeal spasm (HELPS) syndrome was published in 2016 after one year of complete symptom relief following microvascular decompression of their Xth cranial nerve. We now present three additional cases to clarify the core symptoms of this syndrome, highlight its prevalence, and discuss the diagnostic tests, surgical technique and outcome.

METHODS

Four patients with HELPS syndrome are described with details of their presentation, MR imaging, video-laryngoscopy, intra-operative findings, and clinical outcomes.

RESULTS

All four presented with a 4-6 year history of intermittent but progressive throat contractions (choking) and cough. Symptoms increased in frequency, duration and severity

and occurred while sleeping. The choking caused severe stridor with rare LOC leading to intubation (n=2) and tracheostomy (n=1). Three of the four had lateralized contractions. The coughing was triggered by a 'tickle' deep to the xiphisternum and became severe enough to cause visual phosphenes (n=3), incontinence (n=2), and tussive headache (n=4). MR demonstrated a loop of PICA adjacent to the Xth nerve (n=4). Intra-operative videos during MVD of the Xth nerve are presented and compression of a few of the rootlets of the Xth nerve was found in each case. All four were relieved of their symptoms with follow-up more than 6 months. Post-operative complications included (i) dysphonia (n=3) resolving after one, three and ten days, (ii) dysphagia (n=1) resolving after two months, and (iii) delayed CSF leak (n=1) requiring a dural patch.

CONCLUSIONS

HELPS syndrome is a recognizable condition with a combination of episodic but progressive throat contractions and coughing. MR imaging of a PICA loop adjacent to the Xth nerve should prompt consideration of MVD. When choking is not lateralized, the diagnostic test of choice remains to be defined. All referrals came from a laryngologist (not a neurologist) and all four patients were initially misdiagnosed as psychogenic

4. Microsurgical and Endovascular Treatment of Basilar Tip Aneurysms; Long Term Results

Presenting Author Name, Degree, and Affiliation: **Laligam N Sekhar, MD FACS FAANS**
Co-Author Names and Degrees: Josh Abecassis, MD; Rakshith Shetty, MBBS MCh; Basavaraj Ghodke, MD; Jason Barber, MS; Louis J Kim, MD

INTRODUCTION

Although basilar tip aneurysms are being treated in many institutions by endovascular techniques, some of them are better treated by surgical clipping or bypass and terminal basilar artery occlusion when appropriate surgical experience and expertise exists. It is worthwhile to compare the long term results in a consecutive series of patients from a single institution.

METHODS

150 patients with BA Tip aneurysms treated consecutively in our institution from 2005 until 12/2016 were reviewed retrospectively. Preoperative data collected included: age, sex, smoking status, hypertension, hyperlipidemia, distance from treating institution, Hunt and Hess grade, and aneurysm characteristics such as size, neck dimension, and vessel origin from the aneurysm neck or sac. Details of endovascular and surgical treatment were recorded. Postoperative complications, and discharge status were recorded. The follow up information included: compliance with recommended follow up, mRS at 3 – 6 months, and 1 year intervals, need for retreatment (surgical or endovascular), and aneurysm status.

RESULTS

Approximately one third of the aneurysms were treated by surgical clipping, including 6 patients who underwent bypass with BA occlusion. The remainder were treated by an endovascular technique. On the whole, the patients treated by microsurgery were slightly younger, but had a more complex aneurysm anatomy. The 3 – 6 month outcomes were similar in the two groups, the only determinant of outcome were age, and H/H grade at admission. Endovascular treatment group required many retreatments due to recurrences

during follow up. Nevertheless, there were also 3 recurrences in the microsurgical group. Microsurgery, and endovascular therapy were combined seamlessly in some complex patients, optimizing the outcome

CONCLUSIONS

In centers with adequate experience and expertise, microsurgery remains an important treatment modality for BA tip aneurysms. Patients treated by endovascular method require regular follow up, and more frequent retreatment.

5. Pediatric trigeminal neuralgia (TN): Results with early microvascular decompression (MVD)

Presenting Author Name, Degree, and Affiliation: **Mark E. Linskey, MD**, Professor of Neurological Surgery, UC Irvine, CA

Co-Author Names and Degrees: Wendy Storm, PA-C; Heather Corson, PA-C UC Irvine, Ca

INTRODUCTION

Pediatric TN represents <1.5% of all cases. There are only 3 small case series reported in the literature. Two of the 3 report poor results when patients with TN onset prior to age 21 are operated upon many years later as adults. A third with only 5 patients operated upon before age 18 suggests that better results may be possible.

METHODS

Prospective outcomes analysis of 35 consecutive patients with TN onset prior to age 21 included 26 patients operated upon before age 21 over a 10.5 year period who underwent 37 MVD's (11 bilateral TN; 7 re-do MVD after failed MVD elsewhere). 25 MVD's in 20 patients had a minimum follow up of one year (Range 1 – 11y; Median, 2.5y).

RESULTS

Pediatric TN differs from adult TN. 11/26 (42%) patients had bilateral TN, and 12/26 (46%) had multiple cranial nerve compression syndromes. Complex vascular pathology, multiple blood vessel compression and dominantly venous compression were all more common in pediatric patients than their adult counterparts. 18/25 cases (72%) were initially pain free (PF) after MVD with only 3 recurrences (12%) with 15/25 cases (60%) PF at last follow up. 21/25 (84%) were >75% improved at last follow up. and 22/25 (88%) were >50% improved at last follow up. Only 2/25 (8%) initially had <50% pain improvement, and only 3/25 (12%) had <50% pain improvement at last follow-up.

CONCLUSIONS

Largest series of pediatric TN cases ever prospectively studied and reported. While it confirms that pediatric TN differs from adult TN in several respects, it suggests that the poor results previously reported for MVD in this setting most likely relate to significant duration of symptoms and progression of pathology prior to attempting MVD. Early MVD in the setting of pediatric TN has the potential for excellent results, only slightly lower than those achievable in adults.

6. Hybrid Treatment Strategies for Large Vestibular Schwannomas

Presenting Author Name, Degree, and Affiliation: **Philip Theodosopoulos, MD, University of California, San Francisco, Department of Neurosurgery**

Co-Author Names and Degrees: J. Breshears, C. Partow, T. Tihan, M. McDermott

BACKGROUND

Combination subtotal resection and radiosurgical treatment for large vestibular schwannomas has recently been advocated as optimal surgical strategy for large vestibular schwannomas. However data on the long-term outcomes of such hybrid strategies are lacking and the best treatment for residual disease remains an open question.

METHODS

This retrospective single-institution study included all sporadic vestibular schwannomas treated primarily with subtotal resection at our institution from 2002 – 2015. Patients with less than 1 year of follow-up imaging, and those treated with upfront SRS after surgery, were excluded. The primary outcome was tumor stability or growth requiring salvage treatment.

RESULTS

295 patients underwent primary surgery for vestibular schwannoma at our institution between 2002 and 2015. A subtotal resection was performed in 140 of these cases. 49 cases were excluded due to <1 year follow-up imaging, and 17 cases were excluded due to upfront SRS after surgery. Of 74 observed residual tumors after STR, 57 (77%) were stable at 4.1 years. Seventeen tumors (23%) progressed and required salvage treatment at a median of 2.8 years after STR. Eleven were treated with Gamma Knife (12.5 Gy) at a median interval of 2.6 years after surgery, and all remained clinically stable over a median follow-up of 2.3 years after SRS. Four residual tumors were treated with salvage surgery at a median interval of 5 years after STR, and one was lost to follow-up.

CONCLUSION

A majority (77%) of residual vestibular schwannomas will remain stable after a primary subtotal resection. For residual tumors that progress, SRS is an effective salvage treatment option.

7. Patterns of Facial Nerve Injury in Translabrynthine Resection of Acoustic Neuromas

Presenting Author Name, Degree, and Affiliation: **Marc S. Schwartz, MD, House Clinic, Los Angeles**

In recent years, facial nerve preservation has taken precedence over gross total tumor resection in the microsurgical management of acoustic neuromas. Mastery of “less aggressive” surgery is necessary to minimize facial nerve risk. In our institution, all operations are carried out by a team consisting of a neurotologist, who performs the approach, and a neurosurgeon, who performs definitive tumor resection.

All cases of translabyrinthine tumor resection of acoustic neuromas 3cm or less in the CPA,

excluding patients with NF2 or tumors previously treated with microsurgery or stereotactic radiation, carried out in 2012-2104, were retrospectively reviewed. These cases were performed by the author and any of 7 neurologists. Immediate postoperative facial nerve grade, completeness of tumor resection, and complications were recorded. The neurosurgical operative reports of all cases in which facial nerve grade was House-Brackmann 3/6 or worse were reviewed.

141 cases were identified. Gross total tumor resection was achieved in 78 (55.3%). Other than 7 CSF leaks (5%) and one clinically significant sigmoid sinus thrombosis (0.7%), all successfully treated, there were no complications. There were 7 cases in which facial nerve grade was H-B 3/6 or worse (5.0%). In every one of these cases, the diminution of electrical facial nerve response, as measured at the brainstem, occurred before the facial nerve was directly engaged in dissection over the tumor capsule – that is, during the approach or initial tumor dissection. In the 50 cases in which the neurotologist was of the “senior” generation, facial nerve injury occurred 5 times (10%), while in the 91 cases in which the neurotologist was mid-career or younger, injury occurred 2 times (2.2%) (chi square = 4.16; $p < 0.05$).

With less aggressive resection of acoustic neuromas, facial nerve injury can be minimized. Injury, however, is still prone to occur during the approach, during “hand off,” or during initial intradural dissection. While the neurotologist and neurosurgeon share responsibility for these portions of the case, the difference in injury rate between categories of neurotologist implies that injury does occur during the neurotologic portion. Acknowledgement by all parties of this risk is necessary to achieve the best possible facial nerve outcomes.

8. Retrospective Analysis of Mesenchymal Stem Cell Allograft in Integrated Interbody Cervical Devices for One or More Level ACDF Procedures

Presenting Author Name, Degree, and Affiliation: **Amir Vokshoor, MD**, Institute of Neuro Innovation

Co-Author Names and Degrees: Johny Tran BA Molecular Cell & Biology, Hannah Wroblewski, BA Physics

INTRODUCTION

Anterior cervical discectomy and fusion (ACDF) is currently the most common treatment modality for cervical degenerative disc disease. More than half a million bone grafts are used for spine fusion procedures in the United States each year.¹ Bone grafts for spinal fusion surgery require three essential characteristics – osteoinductive growth factors to signal healing via osteoblastic differentiation of progenitor cells, osteogenic cells for new bone formation, and osteoconduction for bone scaffolding.^{2,3,4,5} Osteobiologic bone grafts vary greatly, thus, understanding the efficacy of various osteobiologics in healing distinct spinal regions is important to find the most effective and optimal care treatment.² This study aims to elucidate the efficacy of successful bone fusion and clinical outcome for patients who underwent one or more level ACDF procedures using allograft with PEEK interbody cages and/or plate fixation.

MATERIALS/METHODS

This study is a retrospective chart analysis and radiographic review of patients from January 2014 to December 2015 who underwent one or more level ACDF procedures with

plate fixation and/or stand-alone PEEK spacers using mesenchymal stem cell allograft. The research team collected the basic personal health information (PHI), consisting of the patient name, date of birth, and date of surgery, of eligible patients to identify suitable cases. Radiographic follow-up included computerized tomography (CT) scans and X-ray images at between 6 and 12 months. Outcomes were measured on BSF - Brantigen Steffee Fraser levels 1, 2, and 3. BSF 3 indicates a successful fusion defined as bone bridging at least half the fusion area with at least the density originally achieved at surgery.⁶ Analyses were performed with chi-squared test, and a p-value < .05 was considered statistically significant.

RESULTS

Overall fusion rate with either osteobiologic was 92.1 percent: Cellentra with 94.7 percent and Osteocel with 90 percent. There was no significant difference in fusion rates for the Osteocel and Cellentra group measured between 6 and 12 months (p=.316). Average age for Osteocel group was 62.7 and for Cellentra 68.3 years to date of surgery. T-tests were performed to test for differences in age between the two groups and no significant difference was found.

CONCLUSION

To our knowledge, our study is the first published to compare the efficacy of two different osteobiologics in ACDF surgery: Cellentra and Osteocel. Our fusion for Osteocel was similar to that mentioned in the literature (87.7%).⁷ Fusion rates from literature for Cellentra were not available. The fusion rates were both effective with Cellentra showing a slight nonsignificant advantage over Osteocel. There was no significant difference in fusion rates for the Osteocel and Cellentra group which were both comparable if not more effective options to the autograft gold standard. It is interesting that Cellentra shows equivalent if not preferable results to Osteocel, given that Osteocel is marketed as having 12x the total cellular concentration as Cellentra.⁸

9. Biological adjuncts to achieving a solid lumbar bony fusion

Presenting Author Name, Degree, and Affiliation: **David L. Westra, M.D.**, Ventura County Neurosurgical Associates

INTRODUCTION

Lumbar fusion is one of the most common procedures performed in the United States with 413,000 being performed in 2008 and the rate expected to increase 7.5% annually. Achieving a solid lumbar fusion has been linked to improved clinical outcomes and therefore achieving a solid bony fusion is paramount in achieving a good clinical outcome.

METHODS

A retrospective analysis and review of the literature was performed on biologics including bone marrow aspirate, platelet rich plasma, and bone morphogenic protein. A total of 70 studies were reviewed with 62 of them focused on bone morphogenic protein.

RESULTS

Bone morphogenic protein had the most literature to determine its efficacy and the fusion rate was near 100% in nearly all studies and the lowest complication rate of 4%, but the

highest costs. Bone marrow aspirate was associated with a fusion rate between 80-90% with a complication rate of 10% from all sources. Platelet rich plasma had only 4 small studies in humans which failed to show a significant increase in fusion rates and a complication rate around 10% in both the treated and non-treated groups.

CONCLUSIONS

Bone marrow aspirate, platelet rich plasma, and bone morphogenic protein are all important tools in achieving a solid bony fusion in the lumbar spine but more research is required to determine to optimum indications for their use.

10. Anchored cervical cage use in cervical spine trauma

John Wanebo, MD-1*, Francisco Ponce, MD-1, Oliver Wanebo-2, Karen Lewandowski, NPH-2, Tyler Gasser, MD-2

1. Barrow Brain and Spine, Phoenix and Scottsdale, Arizona
2. Honor Health, Scottsdale, Arizona

INTRODUCTION

Since the introduction of anchored cervical cages for the stabilization of the cervical spine was introduced in 2009, there has been limited documentation regarding the use in trauma. We report a five year experience using anchored cervical cages in a trauma setting.

METHODS

After approval from the Honor Health Institutional Review Board, a retrospective review of all cervical spine trauma patients treated surgically by two neurosurgeons (JW, FP) for sub axial traumatic cervical injuries admitted to Scottsdale Osborn Medical Center was performed using hospital and clinic follow up charts and imaging for patients admitted between July 2012 and March 2017. This reflects 800 days of neurosurgical call at an ACS Level 1 Trauma Center. Clinical records reviewed. Lateral C spine flexion and extension views assessed by a radiologist (TG), blinded to patient identity.

RESULTS

35 patients identified M:F (26:9). Mean age 54.6 (19-88) with 14 being over 65. Mean clinical follow up 4.1 mos (0.5-24), Mean radiographic follow up: 3.8 mos (0.5-18.5). These trauma patients had a mean length of stay of 13.4 days (1-78) with a mean ICU stay of 7.3 days. Cause of trauma included: MVA (12), ground level fall (8), fall from height (5), motor cycle/ATV crash (5), bicycle crash (3), pedestrian strike (1), and diving accident (1). Specific categories of cervical spine injuries included these: fracture dislocation (16), acute herniated disc (8), ligamentous Chance fracture (5), and cervical stenosis with cord contusion (4), and instability in a collar (8). Multiple level C spine injuries occurred in 11. Locked or perched facets seen in 4. Injury syndromes included: Central cord syndrome 9, spinal cord injury with quadraparesis (3), motor deficits (12), radiculopathy (3), and myelopathy (2). Surgical treatment: Forty three cervical levels were treated in 36 surgical ACDF procedures including: C6/7 (15), C5/6 (13), C4/5 (8), C3/4 (3), C2/3 (3), and C7T1 (1). All 35 patients received surgical treatment with an anchored cervical cage which either had a zero profile plate (15) which recessed into disc space, a half plate (8) or a full plate (20). Three patients were treated with Globus Coalition devices while the remainder had the Alta device from Zimmer Biomet. Five patients had two and one had three cervical levels treated. No patients required augmentation of the ACDF with posterior cervical

instrumentation. All patients were treated in a collar postoperatively except one C6/7 perched facet injury who required a Halo for a concurrent C2/3 fracture. Outcomes: Motor function: 21 remained normal pre and post op. Of 14 with preop motor deficits, 13 improved (2 to normal), and 1 remained stable in follow up. Of 20 patients with sufficient radiographic follow up (mean 6.4 months), 19 patients were fused (95%), as assessed by absence of movement at the fused level on flexion and extension films. Though one of six with multiple level treatment was lost to follow up, the other five patients all fused. No specific device failures noted.

CONCLUSIONS

Anchored cervical cages offer a safe and effective option for instrumenting the cervical spine in the setting of trauma.

11. Treating Cervical and Lumbar Radiculopathies using Irrigated Single Instrumentation Port Endoscopic Visualization

Presenting Author Name, Degree, and Affiliation: **Peter C. Shin, MD, MS, MBA**, University of New Mexico Department of Neurosurgery

Co-Author Names and Degrees: Jessica Roscosky, PAC

INTRODUCTION

Minimally invasive spine surgery presently encompasses several modalities and continues to evolve as surgeons and patients alike seek surgical techniques that least disrupt the human frame. Surgeons have approached modern spinal surgery using open techniques and tubular-based retraction technique using both microscope and endoscope as visualization aid. Single port irrigated endoscopic spine surgery; gaining popularity in Europe and Asia, uses incision less than 1 centimeter in diameter for minimal tissue destruction to accomplish similar surgical outcomes as existing techniques (Fig 1). The object of this abstract is to present single surgeon experience with endoscopic spine surgery at University of New Mexico.

METHODS

From February 2015 to December 2016, University of New Mexico (UNM) endoscopic spine surgery team treated 89 patients (94 procedures) with cervical and lumbar radiculopathies secondary to disc herniations, facet or disc arthropathy, and synovial cysts. Their pre-operative symptomatology and post-operative outcomes were tracked.

RESULTS

Seventy-six patients had lumbar disc herniation resulting in radiculopathy. Fifty-seven patients were treated using awake transforaminal endoscopic discectomy and foraminoplasty. Twenty-two patients were treated using interlaminar discectomy. Seventy-one patients had satisfactory relief of their radicular pain after their first transforaminal or interlaminar discectomies. Eight patients did not achieve satisfactory benefit. One patient had worsening bilateral leg paresthesias and one patient had worse foot drop from preop, which improved.

Nine patients had interlaminar laminectomies. Three had laminectomy only for ligamentous hypertrophy causing claudication. Three had combined laminectomy with

discectomy due to central disc herniation. Three had laminectomy with Synovial Cyst resection. Six of nine patients reported improvement in their symptoms. One patient reported improvement but had history of intermittent urinary incontinence. One patient reported no benefit.

CONCLUSION

Single port irrigated endoscopic spine surgery is a surgical modality offering comparable surgical outcome to other minimally invasive techniques with added benefit of less adjacent tissue destruction and reduced recovery time.

12. SUNDAY ABSTRACTS: Mirzadeh, Tharin, Hayden Gephart, Mummaneni, Chivukula, Little, Scully **A Neurosurgical Future for Type 2 Diabetes Treatment: Hypothalamic Tanycytes and Glucose Homeostasis**

Zaman Mirzadeh MD PhD, Elaine Cabrales BS, Nader Sanai MD Barrow Neurological Institute, Phoenix, AZ

Type 2 diabetes (T2D) is among the most common and costly diseases worldwide, with rapidly increasing global prevalence linked to the obesity epidemic. Mounting evidence implicates the brain in physiological glucose homeostasis and the pathogenesis of T2D, once considered a peripheral disorder of the pancreas. A recent study showed that a single intracerebroventricular injection of fibroblast growth factor 1 (FGF1) activated hypothalamic tanycytes and induced sustained diabetes remission in multiple mouse and rat models of T2D. Tanycytes form a specialized uni- and bi-ciliated ependymal epithelium covering the walls of the infundibular recess. They project long processes into the mediobasal hypothalamus that extensively contact diet-responsive neurons. We have used Cre/loxP conditional knockout strategies to ablate tanycyte cilia in neonatal mice. Compared to littermate controls, the cilia mutant animals exhibit no difference in energy balance or glucose homeostasis when fed a standard chow diet. However, when challenged with a high-fat diet to model diet-induced obesity, cilia mutant animals develop glucose intolerance at a significantly lower rate than controls.

We show that tanycytes express glucokinase in their cilia and glucose transporter 2 at their ventricle-contacting apical surface — two components of the glucose-sensing machinery also found in pancreatic beta cells. These results suggest that tanycytes are an integral component of the hypothalamic circuit regulating glucose homeostasis and may be potential therapeutic targets for T2D.

13. Toward a cure for paralysis: microRNA controls over corticospinal motor neuron development

Presenting Author Name, Degree, and Affiliation: **Suzanne Tharin, MD, PhD**, Stanford University

Co-Author Names and Degrees: Victoria Lu BS, Verl Sithanandan PhD, Jessica Diaz DVM MS, Nicole Gonzalez-Nava BS, Jessica MacDonald PhD, Uwe Ohler PhD, Lincoln Pasquina PhD, Aaron Wheeler, MD, Theo Palmer PhD, Jeffrey Macklis, MD

INTRODUCTION

Paralysis in spinal cord injury (SCI) is largely due to loss of functional corticospinal motor neurons (CSMN), the cortical neurons that control voluntary movement. CSMN do not spontaneously regenerate. Transplantation of stem cell-derived neurons is considered a potential therapeutic strategy. Unfortunately, these populations are heterogeneous and include immature neurons that simultaneously express markers of multiple lineages, placing limitations on their therapeutic potential. Progress requires an understanding of CSMN development. While several transcription factors were recently implicated, the molecular controls that coordinately regulate these transcription factors to specifically generate - or regenerate - mature CSMN, are still unknown. microRNAs (miRNAs) are small, non-coding RNAs that coordinately repress gene pathways through mRNA degradation or translation inhibition. They appear to contribute to early cortical development, potentially providing the still elusive regulatory functions for CSMN development.

METHODS

We profiled miRNA expression in pure populations of CSMN vs. the highly related callosal projection neurons (CPN), obtained via retrograde labeling followed by FACS. Targets of lineage-restricted miRNAs were predicted using bioinformatic searches. Cell cultures were transfected with miR-CSMN1 gain-of-function (GOF), loss-of-function (LOF), and scrambled control lentiviral constructs, followed by immunofluorescence analysis using established markers.

RESULTS

We identified 46 miRNAs that are differentially expressed in developing CSMN vs. CPN. miR-CSMN1 is strongly upregulated in CSMN at postnatal day one and is expressed in CSMN-containing layers of the developing telencephalon. Bioinformatic analysis predicts that it represses two transcription factors that regulate the development of the CSMN-related CPN and are not co-expressed in the same layers. Importantly, miR-CSMN1 controls CSMN cell fate in embryonic cortical culture, with overexpression increasing the %CSMN and antisense-mediated knockdown decreasing it. Similar experiments in iPS cells are currently underway.

CONCLUSIONS

miRNAs play a role in CSMN development. miR-CSMN1 regulates adoption of the CSMN fate, and may enhance future stem cell therapies for SCI.

14. Liquid Biopsy of Limited Use for Spinal Ependymoma Due to Anatomic Sequestration

Presenting Author Name, Degree, and Affiliation: **Melanie Hayden Gephart, MD, MAS**
Assistant Professor of Neurosurgery Stanford University
Co-Author Names and Degrees: Ian David Connolly, MS, Yingmei Li, PhD, Wenying Pan, PhD,
Eli Johnson, BS, Linya You, PhD, Hannes Vogel, MD, John Ratliff, MD, Melanie Hayden Gephart, MD, MAS

Cerebrospinal fluid (CSF) represents a promising source of cell-free DNA (cfDNA) for tumors of the central nervous system (CNS). A CSF-based liquid biopsy may obviate the need for riskier tissue biopsies and serve as a means for monitoring tumor recurrence or response to therapy. Spinal ependymomas most commonly occur in adults, and aggressive resection must be delicately balanced with the risk of injury to adjacent spinal tracts.

In patients with subtotal resection, recurrence commonly occurs. A CSF-based liquid biopsy based on the patient's spinal ependymoma mutation profile has potential to be more sensitive than surveillance MRI, but the utility has not been well characterized for tumors of the spinal cord. In this study, we collected matched blood, tumor, and CSF samples from three adult patients with WHO grade II intramedullary spinal ependymoma. We performed whole exome sequencing on matched tumor and normal DNA to design Droplet DigitalTM PCR (ddPCR) probes for tumor and wild-type mutations.

We then interrogated CSF samples for tumor-derived cfDNA by performing ddPCR on extracted cfDNA. No tumor cfDNA was found in the CSF of our cohort.

We hypothesize that anatomic sequestration limits the role of CSF liquid biopsy for intramedullary spinal cord tumors not directly in contact with CSF.

15. OBESITY IS ASSOCIATED WITH INFERIOR PATIENT REPORTED OUTCOMES FOLLOWING SURGERY FOR DEGENERATIVE LUMBAR SPONDYLOLISTHESIS:AN ANALYSIS OF THE QUALITY OUTCOMES DATABASE

Presenting Author Name, Degree, and Affiliation: **Praveen V. Mummaneni, MD** Joan O'Reilly Endowed Professor Vice Chairman Co-director, UCSF Spine Center Department of Neurological Surgery University of California, San Francisco

Co-Author Names and Degrees: Andrew K. Chan MD, Erica F. Bisson MD, MPH, Mohamad Bydon MD, Steven D. Glassman MD, Kevin T. Foley MD, Eric A. Potts MD, Christopher I. Shaffrey MD, FACS, Mark E. Shaffrey MD, Domagoj Coric MD, John J. Knightly MD, Paul Park MD, Kai-Ming Fu MD, PhD, Jonathan R. Slotkin MD, Anthony L. Asher MD, FACS, Michael S. Virk MD, PhD, Panagiotis Kerezoudis MD, Anthony M. DiGiorgio DO, Regis W. Haid MD, Silky Chotai MD, and Praveen V. Mummaneni MD

INTRODUCTION

In light of differing findings of two recent randomized clinical trials, there is a need to identify patients who may benefit least versus most from surgery for degenerative lumbar spondylolisthesis (DLS). This study investigates the impact of obesity on surgery for DLS.

METHODS

Eleven high-enrolling sites were queried and we found 477 patients undergoing surgery for grade 1 DLS. For univariate comparisons, patients were stratified by BMI ≥ 30 kg/m² (obese) and <30 kg/m² (non-obese). Baseline, 3-month, and 12-month follow-up parameters were collected. PROs included the North American Spine Society (NASS) satisfaction questionnaire, numeric rating scale (NRS) back pain, NRS leg pain, Oswestry Disability Index (ODI), and EuroQoL-5D (EQ-5D) Questionnaire.

RESULTS

We identified 224 obese (47.0%) and 253 non-obese patients (53.0%). Obese patients were younger (60.0 vs 63.3 years, $p < 0.01$), more often had diabetes mellitus (25.4% vs

10.7%, $p < 0.01$), and had higher ASA grades (56.3% vs 32.8% with grades 3 or 4, $p < 0.01$). Obese patients were less independently ambulatory (82.5% vs. 93.7%, $p < 0.01$). Obese patients more often underwent fusion surgery (87.9% vs 78.3%, $p < 0.01$), had higher estimated blood loss (302.9 ± 327.5 vs 213.3 ± 227.0 ml, $p < 0.01$), longer operative times (212.7 ± 95.2 vs 177.2 ± 80.4 min, $p < 0.01$), and longer hospitalizations (3.3 ± 1.6 vs 2.9 ± 2.0 days, $p < 0.01$). At baseline, obese patients had worse NRS back pain, ODI, and EQ-5D scores ($p < 0.05$). Both cohorts improved significantly from baseline for back and leg pain, ODI, and EQ-5D at 12 months ($p < 0.01$). At 12 months, fewer obese patients responded that surgery met their expectations (64.4% vs. 70.1%, $p < 0.01$). In multivariate analyses, BMI, as a continuous variable, was independently associated with worse NRS leg pain, ODI, and EQ-5D at 12 months ($p < 0.05$).

CONCLUSIONS

Obesity is independently associated with inferior pain, disability, and quality of life 12 months post-operatively. These findings may help in expectation setting for obese patients considering surgery.

16. En Bloc Pseudocapsular Resection of Endocrine Active Pituitary Adenoma Improves Surgical Outcomes

Presenting Author Name, Degree, and Affiliation: **Srinivas Chivukula, MD**, Department of Neurological Surgery, University of California, Los Angeles, CA, USA

Co-Author Names and Degrees: Daniel Diaz-Aguilar, BS, Department of Neurological Surgery, University of California, Los Angeles, CA, USA Marilene B. Wang, MD Department of Head & Neck Surgery, University of California, Los Angeles, CA, USA, Marvin Bergsneider, MD, Department of Neurological Surgery, University of California, Los Angeles, CA, USA

INTRODUCTION

Conceptually, en bloc pseudocapsular should improve cure rates given that the pseudocapsule can be infiltrated by tumor. We investigated the remission rate, endocrine and surgical outcomes following en bloc pseudocapsule resection of functional pituitary adenomas resected via endoscopic endonasal surgery (EES).

METHODS

We retrospectively reviewed 91 patients with endocrine active pituitary adenomas who underwent EES (2010 – 2016) for whom en bloc resection was considered possible. These included 29 growth hormone (GH) secreting tumors, 23 adrenocorticotrophic hormone (ACTH) secreting tumors and 39 prolactinomas (PrI). Outcomes were assessed immediately postoperatively and at last follow-up. Patients were grouped by whether en bloc pseudocapsule resection was achieved (Group 1) or not (Group 2).

RESULTS

En bloc pseudocapsule resection (Group 1) was achieved in 7 (24.1%) GH tumors, 10 (43.5%) ACTH tumors and 15 (38.5%) prolactinomas. Immediate surgical remission rates (defined by institutional cutoffs, shown in supplemental figure) were 85.7%, 100% and 100% respectively, significantly higher than those for Group 2 in cases of ACTH tumors ($p = 0.038$). By last follow up, 100% of Group 1 patients were in remission, compared with

96.6% of patients in Group 2. Compared with Group 2, no patient in Group 1 developed postoperative hypopituitarism (n=3, 3.3%, p=0.041) anterior pituitary endocrinopathy (n=2, 2.2%, p=0.027), experienced postoperative cranial nerve palsies (n=2, 2.2%, p=0.028) or incurred cerebrospinal fluid leaks (n=3, 3.3%, p=0.033). One prolactinoma patient in whom en bloc resection was achieved developed postoperative diabetes insipidus, compared to 2 (2.2%) in Group 2.

CONCLUSION

En bloc pseudocapsule resection of pituitary adenomas may offer superior remission rates and lower surgical morbidity compared to traditional intracapsular resection methods.

17. When to resume continuous positive airway pressure devices for obstructive sleep apnea following transsphenoidal surgery: an institutional experience

Presenting Author Name, Degree, and Affiliation: **Andrew S. Little, MD**, Barrow Neurological Institute

Co-Author Names and Degrees: Nicholas Gravbrot, BS, William White, MD

OBJECT

Transsphenoidal surgery for pituitary tumors creates a skull base defect that places patients at risk for developing postoperative spinal leak and pneumocephalus. Obstructive sleep apnea (OSA) is commonly treated with continuous positive airway pressure devices (CPAP). Based on case reports, there is a clinical concern that patients undergoing transsphenoidal surgery are at risk for disturbing the skull base repair by resuming CPAP before the skull base is healed. No studies have systematically examined the use of CPAP in transsphenoidal surgery patients, and no guidelines exist as to when it is safe to resume CPAP. In this study, we present our institutional experience managing patients who use CPAP for OSA.

METHODS

A retrospective analysis of patients with a diagnosis of OSA treated with CPAP who underwent transsphenoidal surgery between May 2013 and September 2016 was conducted using data collected from both inpatient and outpatient clinical records. CPAP was resumed at the discretion of the treating team based on intraoperative findings and severity of the patients' airway concerns. Complications related to withholding CPAP in the perioperative period, such as the need for home oxygen and reintubation, were recorded along with complications related to resuming CPAP.

RESULTS

Of 544 patients who underwent transsphenoidal surgery performed for pituitary pathology, 42 patients (8%) used CPAP preoperatively. In 20 patients, intraoperative CSF leak was encountered and repaired in a multilayered fashion. 38 patients resumed CPAP at a median of 3 weeks after surgery (range 0.14-52 weeks). 4 patients did not resume CPAP. There were no cases of postoperative CSF leak or pneumocephalus either before or after resuming CPAP. patients (9.5%) required supplemental home oxygen. No patients required reintubation for pulmonary complications of OSA, though 1 patient in whom CPAP had not yet been restarted was reintubated after a myocardial infarction.

CONCLUSIONS

Resumption of CPAP in patients with OSA at a median of 3 weeks following transphenoidal surgery did not result in any intracranial complications. However, the delay in resuming CPAP resulted in 4 patients requiring home oxygen. This study represents a first step to understanding the management of OSA in this patient population. We present a proposed treatment algorithm based on the size of intraoperative spinal fluid leak to help guide management and serve as the foundation for systematic and rigorous prospective evaluation of this common clinical scenario.

18. PHASE II STUDY OF BI-WEEKLY TEMOZOLOMIDE PLUS BEVACIZUMAB FOR ADULT PATIENTS WITH RECURRENT GLIOBLASTOMA

Presenting Author Name, Degree, and Affiliation: **Thomas B Scully MD FAANS**, Northwest NeuroSpecialists PLLC Tucson, Arizona

Co-Author Names and Degrees: Michael Badruddoja MD, Marjorie Pazzi, RN, BSN, CCRP, Abhay Sanan MD, Kurt Schroeder MD, Thomas Norton MD,

INTRODUCTION

Bevacizumab is a novel anti-angiogenic agent that has activity in the treatment of recurrent glioblastoma (GBM). Temozolomide can prolong survival for patients with newly diagnosed GBM. At recurrence, alternate dosing of temozolomide has shown to further deplete methyl-guanine-methyltransferase (MGMT) conferring added activity after patients have progressed on the standard dosing regimen. The authors combined bevacizumab with biweekly temozolomide for the treatment of adult patients with recurrent GBM.

PATIENTS AND METHODS

Thirty patients with recurrent GBM were treated with bevacizumab (10 mg/kg i.v.) days 1 and 15 of a 28 day cycle combined with temozolomide (100 mg /m²) days 1-5 and 15-19 on a 28 days cycle. Imaging was assessed at week 4 and then every 8 weeks.

RESULTS

Overall response rate from diagnosis was 51 weeks, the 6 month progression free survival was 52% and median time to tumor progression was 5.5 months.

CONCLUSION

Bevacizumab plus bi-weekly temozolomide was well tolerated and may be an added regimen to be considered for a subset of patients diagnosed with recurrent GBM. MGMT status and quality of life (QoL) measures were also assessed.

MONDAY ABSTRACTS: Chow, Hardesty, Mahan, Loeser, Turner, Kakarla, Veeravagu, Macyszyn, Xu, Berman, James.

Basic Science Award

19. B7-H3 Chimeric Antigen Receptor Modified T Cells Show Potent Anti-Tumor Activity in a Preclinical Model of Glioblastoma

Presenting Author Name, Degree, and Affiliation: **Kevin Kwong-Hon Chow, MD, PhD**, Stanford University Medical Center

Co-Author Names and Degrees: Sabine Heitzeneder, MD Robbie Majzner, MD Peng Xu, MD Johanna L. Theruvath, MD Siddhartha Mitra, PhD Samuel Cheshier, MD Gordon Li, MD Crystal L. Mackall, MD

INTRODUCTION

While initial phase I data suggest efficacy of local delivery of chimeric antigen receptor (CAR) modified T cells against glioblastoma (GBM), their activity remains limited in part by the intensity of antigen expression. Targeting more robust tumor associated antigens (TAAs) may help to improve anti-tumor responses. B7-H3 (CD276), a transmembrane glycoprotein which is overexpressed on many solid cancers including GBM, is a promising target. Here we generate CAR T cells specific for B7-H3 and characterize their function in a preclinical model of glioblastoma.

METHODS

B7-H3 CAR T cells were generated by retroviral transduction of healthy donor peripheral blood mononuclear cells (PBMCs) using a vector designed by our lab. The CAR modified T cells were tested in vitro for their ability to produce proinflammatory cytokines and kill B7-H3 positive glioma cell lines. In vivo activity of B7-H3 CAR T cells was tested using an orthotopic GBM xenograft mouse model.

RESULTS

B7-H3 CAR T cells produced the proinflammatory cytokines interferon-gamma (IFN- γ), interleukin-2 (IL-2), and tumor necrosis factor-alpha (TNF- α) when cocultured with B7-H3 positive glioma cell lines. B7-H3 CAR T cells also killed B7-H3 positive glioma cells in an in vitro cytotoxicity assay. Finally, B7-H3 CAR T cells demonstrated potent anti-tumor activity in vivo, producing tumor regression in our mouse model of GBM and significantly improving survival.

CONCLUSION

B7-H3 CAR T cells effectively target GBM and demonstrate significant anti-tumor activity in our preclinical studies. Efforts to translate this CAR for clinical use are warranted and will add to the armamentarium for treating patients with GBM and other solid cancers.

Clinical Science Award

20. Emergency Department Utilization and Hospital readmission within 30 days after 7,294 Cranial Neurosurgery Procedures at A Tertiary Neuroscience Center

Presenting Author Name, Degree, and Affiliation: **Douglas A. Hardesty, MD**, Department of Neurological Surgery, Barrow Neurological Institute, St. Joseph's Hospital and Medical Center, Phoenix, AZ, USA.

Co-Author Names and Degrees: Michael A. Mooney MD, Benjamin K. Hendricks MD, Joshua Catapano MD, Scott T. Brigeman MD, Michael A. Bohl MD, John P. Sheehy MD, and Andrew S. Little MD, all of Department of Neurological Surgery, Barrow Neurological Institute, St. Joseph's Hospital and Medical Center, Phoenix, AZ, USA.

INTRODUCTION

Hospital re-admission and the reduction thereof has become a major quality improvement initiative in organized medicine and neurosurgery. However, little research has been

performed on why neurosurgical patients utilize hospital emergency departments (ER) with or without subsequent admission in the post-operative setting.

METHODS

Retrospective, single-center ethics-board-approved review of all surgical cranial procedures performed from 6/2013 – 6/2016 in patients who survived to discharge.

RESULTS

We identified 7,294 cranial procedures performed during 6,596 hospital encounters in 5,385 patients. The rate of post-operative ER utilization within 30 days after surgical hospitalization across all procedure types was 13.6 per 100 procedures. The average time to ER visit was postoperative day 12.7 (range 0-29 days). The most common chief complaints were pain control (33%), medical complication (19.5%), and altered mental status (11.2%), but these varied significantly between procedure types. Half (50.0%) of patients presenting to the ER were subsequently admitted to the hospital. We constructed a multivariable backward elimination logistic regression model utilizing surgical procedure type, length of hospitalization, patient age, gender, ASA classification, Severity of Illness (SOI) score, and Risk of Mortality (ROM) score to assess ER utilization. In this model, increased age (OR 0.988, $P < 0.0001$) and deep brain stimulation electrode placement (RR 0.506, $P = 0.0009$) had protective effects. Ommaya reservoir placement (OR 2.72, $P = 0.0009$), cranial cerebrospinal fluid shunt placement (OR 1.37, $P = 0.0002$), and SOI score (OR 1.15, $P = 0.022$) were associated with increased ER utilization.

DISCUSSION

We report the rates of and reasons for ER utilization in a large cohort of post-operative cranial neurosurgical patients. We identified risk factors and protective factors associated with return to the ER after cranial surgery. Most established patient-risk metrics did not predict ER utilization. These findings will direct future quality improvement via prospective implementation of care pathways for high-risk procedures and postoperative pain management.

21. Mini-renaissance in peripheral nerve surgery

Presenting Author Name, Degree, and Affiliation: **Mark A Mahan, MD**, University of Utah
Co-Author Names and Degrees: none

INTRODUCTION

Peripheral nerve surgery has undergone a small renaissance over the past two decades with new procedures, new techniques and broadening indications.

METHODS

We will review the results of nerve transfers for peripheral nerve injury, nerve transfers for spinal cord injury, neurectomies for spasticity, nerve surgery for joint denervation, peripheral nerve stimulation and other topics

RESULTS

Motor outcomes after peripheral nerve injury have been dramatically improved by the use of target nerve transfers. Functional restoration can be achieved by the use of distal nerve transfers for spinal cord injury. Long-term control of spasticity can be created by focal neurectomies of the minute branch to the muscle, akin to botulinum toxin. Joint pain can be meaningfully reduced by surgical denervation. Peripheral nerve stimulation is

improving for various modalities – and might include medical disorders in the future.

CONCLUSION

Peripheral nerve surgery has undergone a mini-renaissance, with rebirth due to improved outcomes, better techniques and widening options for functional restoration.

22. NEUROSURGEONS PURSUING PAIN RELIEF

Presenting Author: **John D. Loeser, M.D.**

Neurosurgeons have played a prominent role in the development of both experimental and clinical models of pain. Their assessments of patient responses to procedures such as sympathectomy, cordotomy and lobotomy have led to insights relevant to the anatomy, physiology and psychology of pain as well as the optimal methods of treating most chronic pain patients: the multidisciplinary pain center. This presentation will highlight the works of Foerster, Leriche, Livingston, Sweet and Noordenbos to trace how modern concepts of pain have evolved. Observations made by neurosurgeons have contributed to improved understanding of the nociceptive nervous system well beyond the refinement of surgical techniques.

23. Elevated Fall Risk in Patients with Adult Spinal Deformity

Godzik J, Mauria R, Hlubek R, Kakarla UK, Turner JD

BACKGROUND

Falls are common, costly, and dangerous in the elderly population. The annual fall rate in adults over the age of 65 ranges from 10-29%. Adult spinal deformity (ASD) is prevalent in the elderly and leads to alterations in posture and gait. However, very little is known about the incidence and risk of falls in this population.

METHODS

ASD patients were retrospectively identified from a single institution. Inclusion criteria: age ≥ 18 years, coronal Cobb $>20^\circ$, sagittal vertical axis (SVA) >5 cm, pelvic tilt (PT) $>25^\circ$, or thoracic kyphosis (TK) $>60^\circ$, and completion of a prospectively collected fall risk questionnaire. Exclusion criteria: inability to walk, neurodegenerative disease, spinal cord injury, or stroke. Falling and fall risk were determined using the validated Morse Fall Scale (MFS). Demographic, radiographic, and health-related quality of life (HRQOL) measures including Oswestry Disability Index (ODI) and Scoliosis Research Society (SRS)-22 were collected. Univariate and logistic regression analyses were used to identify independent predictors of falling.

RESULTS

One hundred forty-three patients were identified. Mean age was 60 ± 16 , 90 (63%) were female. Mean pelvic incidence (PI) was $52^\circ \pm 13$, lumbar lordosis (LL) $38^\circ \pm 21$, PT $24^\circ \pm 13$, T1 pelvic angle (T1PA) $22.7^\circ \pm 13.7$, SVA $6.0^\circ \pm 6.4$ cm, and TK $34^\circ \pm 17$. Incidence of falls over 6 months was 31%; mean MFS fall risk was 36 ± 24 . Patients who fell had higher TK ($p < 0.001$), PI ($p = 0.046$), and PT ($p = 0.025$). On multivariate analysis, PT (OR 1.05, $p = 0.013$) and TK (1.05, $p < 0.001$) were independent predictors of falls when adjusted for relevant covariates. MFS fall risk was significantly associated with PT ($p = 0.001$), T1PA ($p < 0.001$), PI ($p = 0.01$), ODI ($p < 0.001$), SRS Function ($p < 0.001$), SRS Pain ($p < 0.001$), SRS Self ($p = 0.021$), SRS average ($p < 0.001$).

CONCLUSIONS

ASD is associated with greater fall risk and a higher fall rate compared to historical controls of community-dwelling adults of similar age. Increasing TK, PI, and PT were independently associated with high risk of falling, and MFS fall risk correlated with multiple HRQOL measures.

24. Controversies in Spine Deformity Surgery

Presenting Author Name, Degree, and Affiliation: **U. Kumar Kakarla, MD**, Barrow Neurological Institute

25. Scoliosis Surgery: Safety, Value & Efficacy

Presenting Author Name, Degree, and Affiliation: **Anand Veeravagu, MD**, Stanford University

26. Current Concepts and Trends in Spinal Deformity Surgery

Presenting Author Name, Degree, and Affiliation: **Luke Macyszyn, MD**, University of California, Los Angeles

27. Value of neurosurgery in Sub-Saharan Africa: neurosurgical treatment and outpatient outcomes in Uganda

Presenting Author Name, Degree, and Affiliation: **Linda W. Xu, MD**, Department of Neurosurgery, Stanford University, Palo Alto, CA, USA

Co-Author Names and Degrees: Silvia D. Vaca, BS; Juliet Nalwanga, MBChB, M.Med Surg; Christine Muhumuza, MPH; Ben Lerman, BS; Joel Kiryabwire MBChB, M.Med Surg; Hussein Ssenyonjo MBChB, M. Med Surg; John Mukasa, MBChB, M. Med Surg; Michael Muhumuza MBChB, M. Med Surg; Michael Haglund MD PhD; Gerald Grant MD

INTRODUCTION

Neurosurgery as a specialty in Uganda has been growing over the last decade with increasing surgical volume and the launch of a new residency training program. While research to date has examined surgical capacity, we have little to no data on the overall patient population treated by neurosurgery and their eventual outcomes in sub-Saharan Africa.

METHODS

Patients admitted to Mulago National Referral Hospital neurosurgical ward between 2014 and 2015 were documented in a prospective database. 1167 patients were discharged with a phone number on file and thus were eligible for follow-up. Phone surveys were developed and conducted in the participant's language to assess mortality, neurological outcomes, and follow-up healthcare post-discharge.

RESULTS

A total of 2032 patients were admitted to the neurosurgical ward during the study period, 80% for traumatic brain injury. 7.8% received surgical intervention. The rate of in-hospital mortality was 18%. 870 patients were reached for phone follow up, resulting in a 75% response rate. 30-day and 1-year mortality was 4% and 8%, respectively. Almost half of

the patients had not had any subsequent medical care since the initial encounter. The majority of patients had GOSE scores consistent with good recovery and mild disability, with trauma patients faring the best and tumor patients faring the worst. 85% felt they returned to their prior baseline performance at work, and 76% of guardians felt that children returned to their baseline performance at school.

CONCLUSIONS

The neurosurgical service provided medical care to a large proportion of non-operative patients. The method of phone surveys was very effective in capturing data on patients who previously nearly half would have been lost to follow up. While mortality during initial hospitalization was high, for those patients who were able to discharged, over 90% survived at 1 year follow up and the vast majority were able to return to work and school.

28. Anatomical and surgical behavior of metastatic calvarial tumors with intracranial extension

Blake W. Berman, D.O., Javed Siddiqi, M.D., PhD. (Desert Regional Medical Center, Arrowhead Regional Medical Center)

OBJECTIVE

Metastatic calvarial tumors may extend intracranially. When this occurs the anatomical behavior is very distinct. There is invasion, adherence, and dysplasia of dura which does not occur when the tumor extends to brain parenchyma. In the brain there is compression that does not appear to extend beyond the arachnoid layer, and they are loosely adherent unlike other extra-axial masses such as meningiomas. Our objective is to discuss and illustrate the anatomical and surgical characteristics of metastatic calvarial tumors with intracranial extension.

METHODS

A series analysis of three similar cases of metastatic calvarial masses with intracranial extension from three different primary tumor sources; melanoma, breast, and lung.

RESULTS

All three lesions behaved in identical fashion in that there appears to two separate components; a calvarial component that is distinct and easily separated from underlying dura, and an intracranial component that is invasive to dura and totally non-adherent to the brain.

DISCUSSION

Three similar cases of metastatic calvarial masses with intracranial extension from three different primary tumor sources were operated for surgical resection due to mass effect and midline shift of the brain with altered level of consciousness. Case one is a 72 year old African American female with metastatic lung cancer, case two is a 68 year old female with metastatic breast cancer, and case three is a 54 year old male with metastatic melanoma. All three were operated by the same surgeon over a 4 year period of time. Each of the three patients recovered and went on to receive adjuvant chemotherapy and/or radiation therapy where appropriate. In all three cases the surgical findings were essentially identical in that there appears to two separate components; a calvarial component that is distinct and easily separated from underlying dura, and an intracranial component that is invasive to dura and totally non-adherent to the brain. When comparing the intradural portion of the mass we found that these are easily separated from the brain since they do

not invade the arachnoid. In contrast to other intradural extra-axial tumors such as meningioma, we believe this is due to both timing from discovery to surgery and due to the cells from which the tumors are derived. In the case of meningioma, these are derived from arachnoid cap cells and follow an indolent course with respect to their growth. As they grow over many years they split the arachnoid and become adherent to brain parenchyma. In contrast, metastatic calvarial tumors, in addition to not deriving from meningeal tissue, follow a rapidly progressive course which likely does not all for enough time to infiltrate and adhere.

CONCLUSION

Metastatic calvarial tumors, regardless of the primary histology, behave very similarly from a surgical prospective in that there appears to two separate components; a calvarial component that is distinct and easily separated from underlying dura, and an intracranial component that is invasive to dura and totally non-adherent to the brain.

Key Words: Metastatic calvarial tumor(s), dura, meninges, meningioma

29. Pore and Glymphatics Theories and Shunt Malfunction: Report of a Case and Theory Discussion

Presenting Author Name, Degree, and Affiliation: **Hector E. James, M.D.**

INTRODUCTION

This is a case report of a child with a shunt embedded in the brain parenchyma that was draining CSF from the ipsilateral ventricle, an attempt to explain this by pore and glymphatic theories.

MATERIALS/METHODS

A newborn child with congenital heart disease underwent cardiac surgery and recovered well. One week post discharge he was noted to have a full fontanelle and split cranial sutures. MRI revealed moderate hydrocephalus and a ventriculoperitoneal shunt was placed. Follow-up MRI at 3 months revealed a reduction of ventricular size and the ventricular catheter was in the ipsilateral ventricle. At 10 months the patient was asymptomatic, but his head circumference had risen from the 25th percentile to the 40th percentile. MRI at this time demonstrated small ventricles with all of the ventricular catheter in the brain parenchyma. The parents requested the shunt be removed. In the operating room under general anesthesia, the shunt reservoir puncture yielded 15mL clear CSF, then 10mL of air was injected. Immediate intraoperative CT scan was performed and demonstrated air in the ipsilateral frontal horn. The ventricular catheter was replaced with a new one. The valve and distal catheter were functioning correctly.

RESULTS

The CSF in the shunt may have traveled through the parenchymal shunt track because of transmantle pressure gradient, as explained by the Pore Theory.¹ Alternative explanation could be interstitial movement of CSF from the ventricle by the glymphatic system facilitated by the general anesthesia.² Alternatively, it could be a combination of both.

CONCLUSIONS

Ventricular catheters lodged in the brain may be still draining CSF from the lateral ventricle

and this needs to be considered before shunt removal.

1 Kim H, et al. J Neurosurg 2016;124:334-341

2 Xie L, et al. Science 2013;342:373-377

30. LATE CAREER OBLIGATION AND HAPPINESS

Presenting Author Name, Degree, and Affiliation: **Richard Rapport, MD**, Clinical Professor, Department of Neurological Surgery, University of Washington School of Medicine

Harvey Cushing, though a great innovator, was not a pleasant man. According to biographer Michael Bliss, his late career—disturbed by family unrest and tragedy—grew especially unhappy. However, his intense personality did influence the way neurosurgeons both operated and behaved for seven decades. Time and modern imaging have changed us. Still when we finally leave the operating room, there is of necessity a void. Avoiding Cushing's example, cultivating a philosophy of continued obligation can lead to late career happiness. Wisdom isn't really acquired by most normal people. One must be a little mad to find that: Jesus, Aristotle, Mozart, Gandhi, Wittgenstein, Einstein, Heisenberg. As a practical matter one gets back in life that which one projects. If we cannot gain wisdom, most of us can at least find something obtainable for more normal people: heuristic understanding and an appreciation of the "other," a larger human self. This leads to empathy, and maybe a kind of what we call immortality, if by that we mean being remembered well by a few people for a little while, which is really all we get. There are philosophers who contend that life is the interval between two nothings. Epicurus was one such when he said, "I was not. I have been. I am not. I do not mind." To find happiness, people must pay attention to how they live, try to be unselfish, love others even when they are unlovable, and remain dedicated to their work. Continuing to work with unfortunate, disadvantaged patients and to show medical students and residents a way to be good doctors does result in preserved contribution and happiness. Such a post-operating room life is possible.



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Randall Smith	2009-2013
Moustapha Abou-Samra	2014-2016

*deceased

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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, 1958
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, 1962
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-Oct 1, 1986
33. Banff Springs Hotel, Banff, AB
Sept 6-9, 1988
34. The 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
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, 2004
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. Phillip Carter	Oct. 8-11, 2010
57. The Grand Hyatt Kauai Resort & Spa, Island of Kauai, HI	Sept. 10-13, 2011
58. Broadmoor Hotel, Colorado Springs, CO	Sept. 7-10, 2012
59. Ritz Carlton Half Moon Bay, Half Moon Bay, CA	Sept. 15-18, 2013
60. The Lodge, Sun Valley, ID	Aug. 16-19, 2014
61. Grand Hyatt Kauai Hotel, Kauai, HI	September 10-13, 2015
62. Park Hyatt Aviara, Carlsbad, CA	September 9-12, 2016

FUTURE MEETINGS

2018 Fairmont Orchid Resort, Island of Hawaii, HI,	September 14-17, 2018
2019 Hyatt Regency at Gainey Ranch, Scottsdale, AZ,	November 8-11, 2019
2020 Fairmont Grand Del Mar, San Diego, CA,	August 28-31, 2020

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James R. St. John*	1972	Gerald Silverberg	2004
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Thomas K. Craigmile*	1975	Philip Weinstein	2007
Lyman Maass*	1976	Betty MacRae	2008
Gale C. Clark*	1977	Linda Liau	2009
William A. Kelley *	1978	David W. Newell	2010
Byron C. Pevehouse*	1979	J. Paul Muizelaar	2011
Robert W. Rand*	1980	Richard Wohns	2012
Theodore S. Roberts*	1981	Marc Vanefsky	2013
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Lester B. Lawrence*	1968	Donald J. Prolo	2001, 2002
John D. French*	1969	Grant E. Gauger	2003
Chester B. Powell*	1970	Randall W. Smith	2004
Robert W. Porter	1971	John P. Slater	2005
Henry M. Cuneo*	1972	Moustapha Abou-Samra	2006
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James R. St. John*	1976	David W. Newell	2010
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Gale C. Clark*	1986		
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Roy A.E. Bakay, UW	1979
Herbert Fried, UCLA	1980
Linda M. Liao, UCLA **	1997
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Michael Y. Wang, USC	2000
Odette Harris, Stanford**	2001
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Michael Sandquist, OHSU	2003
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Mathew Hunt, OHSU	2005
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Jonathan Miller, OHSU	2007
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Terry Burns, Stanford	2011
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Anand Veeravagu, Stanford	2013
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