41st Annual Meeting of the AANS/CNS Section on Pediatric Neurological Surgery

Safety. Efficacy. Efficiency.

PEDIATRIC NEUROSURGERY.

Program Book

November 27-30, 2012
St. Louis Union Station Hotel,
A DoubleTree By Hilton
St. Louis, Missouri

Jointly sponsored by the AANS

American Association of Neurological Surgeons
and the American Association of Neurosurgeons

Congress of Neurological Surgeons

NEW MEETING APP AVAILABLE

For the first time, the entire program is accessible via our new Apple/Android compatible app. For your convenience, please visit the app store to download this user-friendly application to your mobile device. The "Messages" link will provide attendees with any changes in program electronically.

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FUTURE MEETING SITE

2013 Toronto, Canada
December 3-6, 2013

PAST ANNUAL MEETING SITES

1972	Cincinnati	**1994**	St. Louis
1973	Columbus	**1995**	Pasadena
1974	Los Angeles	**1996**	Charleston
1975	Philadelphia	**1997**	New Orleans
1979	New York	**1998**	Indianapolis
1980	New York	**1999**	Atlanta
1981	Dallas	**2000**	San Diego
1982	San Francisco	**2001**	New York
1983	Toronto	**2002**	Scottsdale
1984	Salt Lake City	**2003**	Salt Lake City
1985	Houston	**2004**	San Francisco
1986	Pittsburgh	**2005**	Orlando
1987	Chicago	**2006**	Denver
1988	Scottsdale	**2007**	South Beach (Miami)
1989	District of Columbia	**2008**	Spokane
1990	San Diego/ Pebble Beach	**2009**	Boston
		2010	Cleveland
1991	Boston	**2011**	Austin
1992	Vancouver, BC	**2012**	St. Louis
1993	San Antonio		

AANS/CNS SECTION ON PEDIATRIC NEUROLOGICAL SURGERY

November 27-30, 2012
St. Louis, Missouri

CONTINUING MEDICAL EDUCATION CREDIT

This activity has been planned and implemented in accordance with the Essential Areas and policies of the Accreditation Council for Continuing Medical Education through the joint sponsorship of the AANS and the AANS/CNS Section on Pediatric Neurological Surgery. The AANS is accredited by the ACCME to provide continuing medical education for physicians.

The AANS designates this live activity for a maximum of 35.25 *AMA PRA Category 1 Credits™*. Physicians should claim only the credit commensurate with the extent of their participation in the activity.

A maximum of 15.75 *AMA PRA Category 1 Credits*™ can be claimed for general sessions and a maximum of 19.50 *AMA PRA Category 1 Credits*™ can be claimed for the ticketed sessions.

For the Mid-Level Practitioner's Seminar: This continuing nursing education activity was approved by the American Association of Neuroscience Nurses (AANN), accredited as an approver of continuing education by the American Nurses Credentialing Center's COA.

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ANNUAL MEETING LEARNING OBJECTIVES

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

- Review national quality and safety initiatives
- Discuss updates on recent advances in brain tumors, spasticity, Chiari malformations and syrinx
- Apply recent advances in spine and endoscopy techniques
- Discuss the economic realities of practicing pediatric neurosurgery

CLAIM CME CREDIT THE EASY WAY

Again this year, attendees will self-report CME credit for the programs they attend by going online to MyAANS.org from any computer with internet service. Please have your MyAANS.org username [e-mail address] and password handy during and after the meeting for convenient completion and submission.

Do not self-report CME credit for the optional ticketed events; Practical Clinics, Breakfast Seminars and Mid-Level Practitioner's Seminar. By turning in your ticket on-site, credit will automatically be added to your record in MyAANS.org.

WHO SHOULD ATTEND

The educational sessions will be directed towards pediatric neurological surgeons, residents, nurse clinicians and physician assistants and will be directly applicable to their practices.

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1975–76 Kenneth Shulman
1976–77 E. Bruce Hendrick
1977–78 Frank Nulsen
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2009-11 Ann-Christine Duhaime
2011-13 Alan R. Cohen

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David I. Sandberg, MD (2010-)

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Vacant

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Transition of Care Committee
Vacant

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Ann-Christine Duhaime, MD (2010)
Ed Smith, MD (2012)

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Suresh Magge, MD (2012)

Liaison to the Neuro-Critical Care Society
Ashutosh Singhal, MD (2010)

Liaison to Quality/Outcomes Groups
Liliana C. Goumnerova, MD (2010)

KEYNOTE SPEAKERS

2012 RAIMONDI LECTURE

ROSEMARY GIBSON, MSc

Rosemary Gibson is a national leader in healthcare quality and safety and a Section Editor of the *Archives of Internal Medicine* "Less is More" series. She is principal author of the new book, *The Battle Over Health Care: What Obama's Health Care Reform Means for America's Future,* a non-partisan analysis of the future state of health care and its impact on the economy.

Rosemary led national healthcare quality and safety initiatives at the Robert Wood Johnson Foundation for sixteen years in Princeton, New Jersey. She was chief architect of the foundation's decade long strategy to establish palliative care in the mainstream of the U.S. health care system. She worked with Bill Moyers and Public Affairs Television on the PBS documentary, "On Our Own Terms," which showed to more than 20 million viewers how the U.S. healthcare system can better care for seriously ill patients and their families. She initiated a series in the Journal of the American Medical Association, "Perspectives on Care at the Close of Life."

Rosemary is author of the critically acclaimed books, *Wall of Silence,* which tells the human story behind the Institute of Medicine report, *To Err is Human,* and *The Treatment Trap,* a book on the overuse of medical care. Her books have been reviewed in the *Journal of the American Medical Association, Health Affairs* and *Publishers Weekly,* referenced in proceedings of the U.S. Senate, mentioned in Congressional testimony, noted in *The Wall Street Journal* and the *Boston Globe,* and highlighted in the anniversary issue of *O Magazine.*

Earlier in her career, Rosemary served as Senior Research Associate at the American Enterprise Institute, a Washington, D.C.-based public policy organization; as Vice President of the Economic and Social Research Institute, a policy think tank; and as consultant to the Medical College of Virginia and the Virginia state legislature's Commission on Health Care. She was a volunteer and Board member at a free medical clinic in Washington, D.C.

Rosemary is a graduate of Georgetown University and has a master's degree from the London School of Economics.

2012 AAP/SECTION ON NEUROLOGICAL SURGERY (SONS) SPECIAL LECTURE

TERRIE INDER, MD

Dr. Inder is a dual-boarded child neurologist and neonatologist, who directs clinical and translational research into the nature and timing of brain injury in the preterm and high risk term born infant. She is the director of the Washington University Neonatal Development Research (WUNDER) team and the Washington University Intellectual and Developmental and Disabilities Research Center (WUIDDRC).

The WUNDER team conducts multidisciplinary research initiatives in pediatrics, neurology, radiology, obstetrics, and psychology centering back on studies at the bedside of newborn infants in the neonatal and pediatric intensive care unit at St. Louis Children's Hospital. The team focuses on efforts in the premature infant, the sick term infant, and the infant with cardiac diseases. This research utilizes state of the art technologies in magnetic resonance (MR) imaging and electroenecephalography (EEG) as tools to assist in understanding the timing and nature of brain injury in the newborn infant.

The WUIDDRC consists of 4 research cores in imaging, neuropsychology and genetics, animal models, biostatistics and bioinformatics to accelerate research findings in infants and children both at risk and with developmental disabilities. The center is funded by the National Institute of Health and supports over 50 investigators in addition to a central role in advocacy and support for children with developmental disabilities.

Finally, Dr. Inder holds a Doris Duke Distinguished Clinical Scientist Award to assist her passion in the mentoring of young clinical scientists.

LECTURERS

RAIMONDI LECTURERS

1978 E. Bruce Hendrick
1979 Paul C. Bucy
1980 Floyd Gilles
1981 Panel Discussion
1982 Panel Discussion
1983 Derek Harwood-Nash
1984 Anthony E. Gallo Jr.
1985 Frank Nulsen
1986 William F. Meacham
1987 Dale Johnson
1988 Joseph J. Volpe
1989 Martin Eichelberger
1990 George R. Leopold
1991 Judah Folkman
1992 Olof Flodmark
1993 Maurica Albin
1994 Blaise F.D. Bourgeois
1995 Robert H. Pudenz
1996 Samuel S. Flint
1997 M. Michael Cohen Jr.
1998 Robert A. Zimmerman
1999 David B. Schurtleff
2000 Steve Berman
2001 Alejandro Berenstein
2002 Volker K.H. Sonntag
2003 Jon Huntsman
2004 J. Michael Bishop
2005 James B. McClintock
2006 Richard D. Lamm
2007 Roberto C. Heros
2008 Renée Jenkins
2009 Charles Stiles
2010 Richard C. Karl
2011 Mack Brown
2012 Rosemary Gibson

MATSON MEMORIAL LECTURERS

1987 John Shillito
1988 E. Bruce Hendrick
1989 Martin P. Sayers
1990 Roger Guillemin
1991 Robert L. McLaurin
1992 Joseph Murray
1993 Eben Alexander Jr.
1994 Joseph Ransohoff
1995 John Holter
1996 None
1997 Maurice Choux
1998 Lisa Shut
1999 Gary C. Schoenwolf
2000 Postponed due to illness
2001 Donald H. Reigel
2002 David McLone
2003 Robin P. Humphreys
2004 A. Leland Albright
2005 Joan L. Venes
2006 James P. McAllister, James M. Drake, Joseph R. Madsen, Edward H. Oldfield
2007 Harold L. Rekate
2008 Marion L. Walker
2009 John A. Jane Sr.
2010 Jeffrey A. Golden
2011 Thomas G. Luerssen
2012 Scott L. Pomeroy

FRANC INGRAHAM AWARD FOR DISTINGUISHED SERVICE AND ACHIEVEMENT RECIPIENTS

1988 E. Bruce Hendrick
2001 Luis Schut
2004 Fred J. Epstein
2007 Robin P. Humphreys
2009 David G. McLone
2010 Robert Alex Sanford
2011 R. Michael Scott

AWARD RECIPIENTS

KENNETH SHULMAN AWARD RECIPIENTS

1983 Kim Manwaring
Neonatal Post-Hemorrhagic Ventriculomegaly: Management with Pulsed Lumbar Cisternostomy

1984 Arno Fried
A Laboratory Model of Shunt-Dependent Hydrocephalus

1985 Ann-Christine Duhaime
The Shaken Baby Syndrome

1986 Robert E. Breeze
Formation in Acute Ventriculitis

1987 Marc R. Delbigio
Shunt-Induced Reversal of Periventricular Pathology in Experimental Hydrocephalus

1988 Scott Falci
Rear Seat-Lap Belts. Are They Really "Safe" for Children?

1989 James M. Herman
Tethered Cord as a Cause of Scoliosis in Children with a Myelomeningocele

1990 Christopher D. Heffner
Basilar Pons Attracts its Cortical Innervation by Chemotropic Induction of Collateral Branch Formation

1991 P. David Adelson
Reorganization of the Cortical-Tectal Pathway Following Neonatal Cerebral Hemispherectomy in Cats

1992 David Frim
Effects of Biologically Delivered Neurotrophins in Animal Models of Neural Degeneration

1993 Monica C. Wehby
Metabolic Demonstration of Retained CNS Function in the Rabbit Model of Infantile Hydrocephalus

1994 Ellen Shaver
Experimental Acute Subdural Hemotoma in Infant Piglets

1995 Seyed M. Emadian
Correlation of Chromosome 17p Loss with Clinical Outcome in Patients with Primitive Neuroectodermal Tumors

1996 John Park
Platelet Derived Growth Factor Induces Differentiation of Neuroepithelial Stem Cells into Neurons

1997 Michael J. Drewek
Quantitative Analysis of the Toxicity of Human Amniotic Fluid to Rat Fetal Spinal Cord Cultures

1998 Adrianna Ranger
Implantation of Medulloblastoma Cells into Collagen Type I Gels: Invasiveness, Enzymatic Characterization, and the Impact of Surgical Excision and Radiation

1999 Susan Durham
The Surprisingly Sturdy Infant Brain: Why is it More Resistant to Focal Injury?

2000 Ketan R. Bulsara
Novel Findings in the Development of the Normal and Tethered Filum Terminale

2001 David I. Sandberg
Convection Enhanced Delivery into the Rat Brain Stem: A Potential Delivery for the Treatment of Diffuse Pontine Gliomas

2002 David Cory Adamson
Mechanisms of Reclosure in 2 Surgical Models of Myelomeningocele Implications for Fetal Surgery

2003 Joshua E. Medow
Posture Independent Piston Valve: A Practical Solution to Maintaining Stable Intracranial Pressure in Shunted Hydrocephalus

2004 Joshua E. Medow
The Permiable Proximal Catheter Project: A Novel Approach to Preventing Shunt Obstruction

2005 David Cory Adamson
Digital Karotyping Identifies a Novel Retinoblastoma Oncogene

2006 Elias B. Rizk
Folate Receptor Function is Essential in CNS Recovery after Injury: Evidence in Knockout Mice

2007 Jeffrey P. Greenfield
A Stem Cell Based Infiltrative Model of Pontine Glioma

2008 Toba Niazi
Medulloblastoma Growth Enhancement by HGF/SF Expression in Cerebellar Neural Progenitor Cells is Suppressed by Systemic Antibody Treatment

2009 Symeon Missios
Cell Proliferation and Neuronal Migration after Closed Head Injury in the Immature Piglet

2010 Amanda Muhs Saratsis
Proteomic Analysis of Cerebral Spinal Fluid From Children With Brainstem Glioma

2011 Paul Gigante
Effects of Lumbar Selective Dorsal Rhizotomy on The Upper Extremeties in Children

AWARD RECIPIENTS

HYDROCEPHALUS ASSOCIATION AWARD RECIPIENTS

1989 Eric Altschuler
Management of Persistent Ventriculomegaly Due to Altered Brain Compliance

1990 Shalom Michowiz
High Energy Phosphate Metabolism in Neonatal Hydrocephalus

1991 Nesher G. Asner
Venous Sinus Occlusion and Ventriculomegaly in Craniectomized Rabbits

1992 Marcia Da Silva
Reversal of High Energy Phosphate Metabolism Changes in Experimental Hydrocephalus after CSF Shunting

1993 Charles Bondurant
The Epidemiology of Cerebrospinal Fluid Shunting

1994 Monica C. Wehby-Grant
The Rabbit Model for Infantile Hydrocephalus: Regional Differences in the Cortical Metabolic Response to Hydrocephalus and Shunting

1995 Richard J. Fox
Cerebrospinal Fluid Absorptive Site of the Parasagittal Dura: A Cadaveric Study

1996 Martha J. Johnson
Reactive Astrocytosis in a New Model of Obstructive Hydrocephalus

1997 No Prize Awarded

1998 Daniel Lieberman
In Vetro Detection of Fluid Flow in Ventriculoperitoncal Shunts (VPS) Using Contrast Enhanced Ultrasound

1999 Kimberly Bingaman
Hydrocephalus Induces the Proliferation of Cells in the Subventricular Zone

2000 No Prize Awarded

2001 Jake Timothy
Treatment of Hydrocephalus Using a Choroid Plexus Specific Immunotoxin: An In Vitro Study

2002 Joshua Medow
Quick Brain MRI vs. CT Scan for Evaluating Shunted Hydrocephalus

2002 Jonathan Miller
Abberant Neuronal Development in Hydrocephalus

2003 Martin U. Schuhmann
Serum and CSF C-Reactive Protein in Shunt Infection Management

2004 Jeffrey Pugh
Can the Skull Diploic Space Be Utilized for Absorption of Cerebrospinal Fluid?

And

Jay K. Riva-Cambrin
Pediatric Posterior Fossa Tumors: Pre-Operative Predictors of Chronic Hydrocephalus

2005 Jeffrey P. Greenfield
Intraoperative Assessment of Third Ventriculostomy Success

2006 Kurtis I. Auguste
Greatly Impaired Migration of Aquaporin-4 Deficient Astroglial Cells After Implantation into Mouse Brain

2007 No Prize Awarded

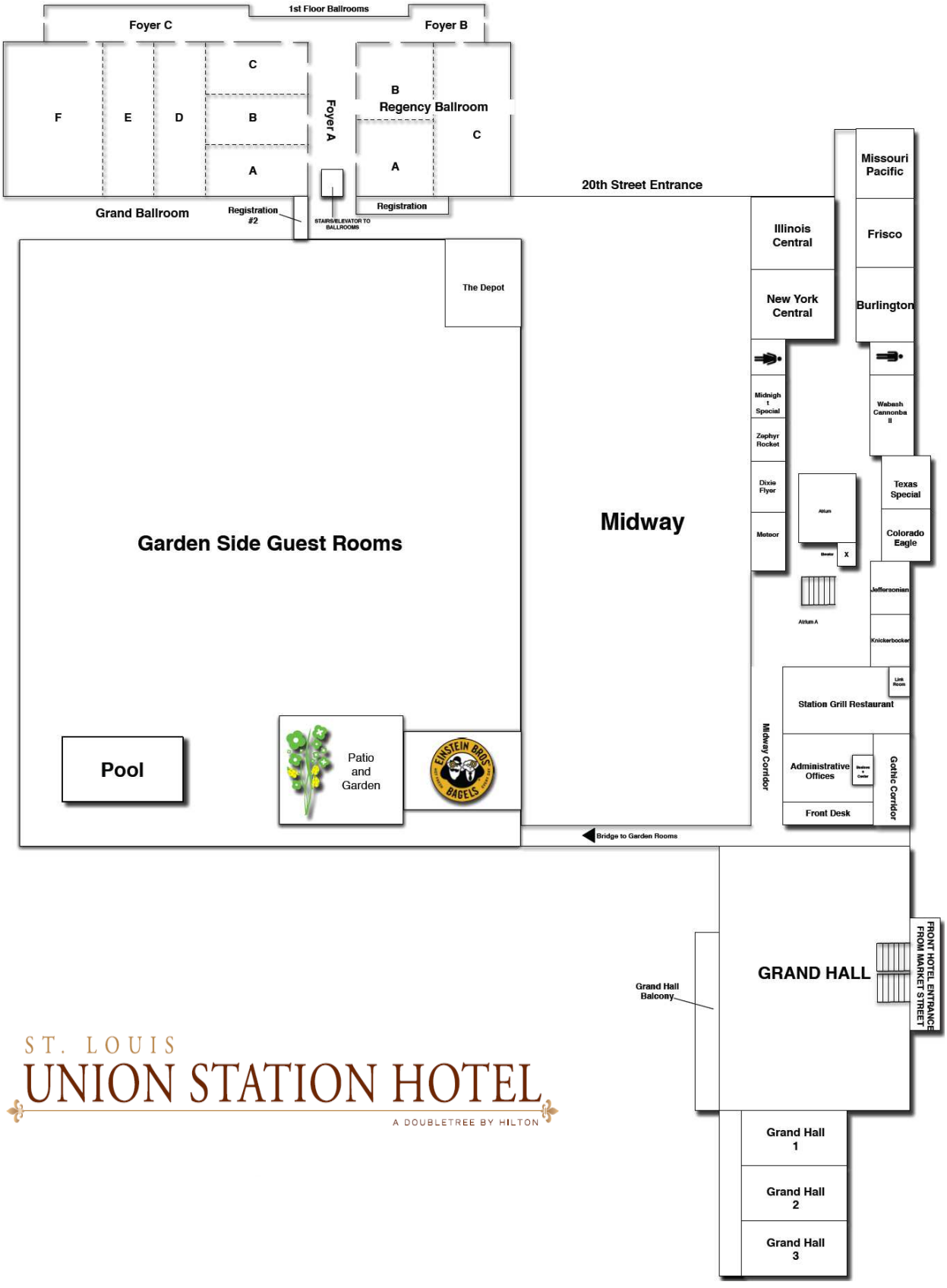
2008 Ellen L. Air
A Longutudinal Comparison of Pre- and Post-operative DTI parametes in Young Hydrocephalic Children

2009 Christopher Janson
Immortalization and Functional Characterization of Rat Arachnoid Cells

2010 Ramin Eskandari
Effects of Early And Late Reservoir Treatment in Experimental Neonatal Hydrocephalus

2011 Ashley Grosvenor Tian
Bilateral High Grade Intraventricular Hemorrhage is Associated With Male Sex, Younger Gestational Age And Lower Birth Weight, But Not Other Perinatal Factors

MEETING ROOM FLOOR PLAN



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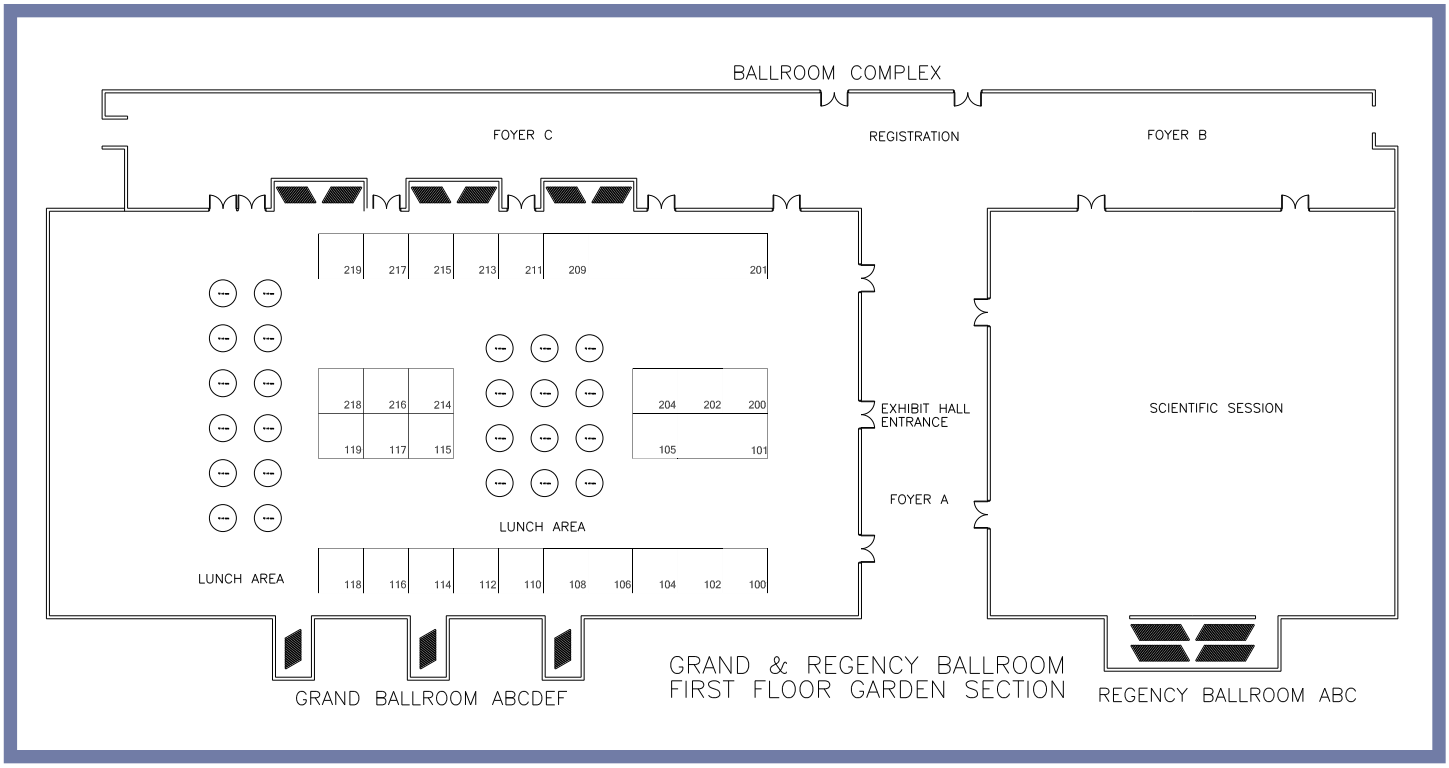
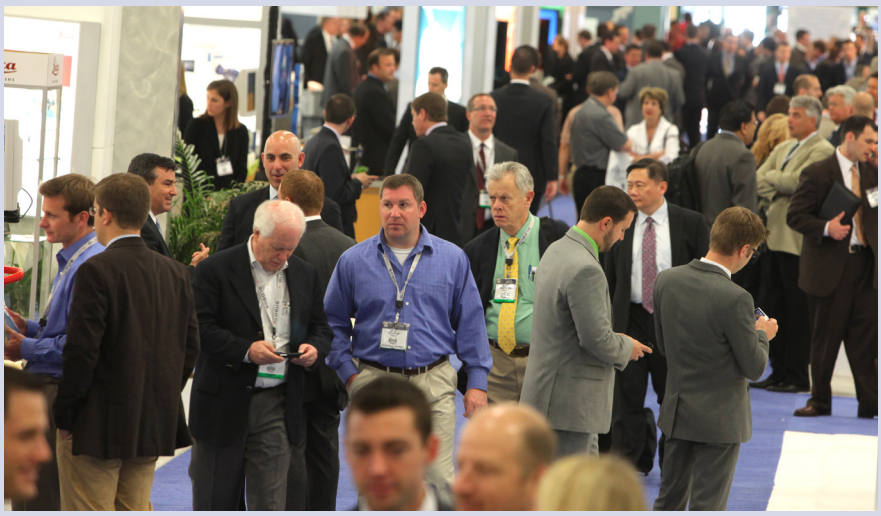
UNION STATION HOTEL
A DOUBLETREE BY HILTON

EXHIBIT HALL FLOOR PLAN





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Booth #216

The Hydrocephalus Association is a national non-profit organization. Our mission is to eliminate the challenges of hydrocephalus by stimulating innovative research and providing support, education and advocacy for individuals, families and professionals dealing with the complex issue of the condition. The Association provides comprehensive services that empower individuals and families.

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Booth #211

Kogent Surgical designs and distributes a comprehensive line of neurosurgical handheld titanium instruments, designed with the help of Robert F. Spetzler, MD, and other luminary neurosurgeons. Also available are a variety of disposable malleable suction tubes, including innovative illuminated suction tubes. Stop by our booth to see much more!

Leica Microsystems
1700 Leider Lane
Buffalo Grove, IL 60089
Phone: (847)821-3447
Fax: (847)405-2099
www.leicamicrosystems.com
Booth #204

The Best just got Better. Designed with you in mind, the Leica Microsystems M720 OH5 neurosurgical microscope with compact horizontal optics is a paradigm shift in vision, comfort, and flexibility. See more than ever before with NEW Small Angle Illumination and TrueVision® 3D – the next generation in 3D teaching technology.

Lippincott, Williams and Wilkins/Thieme
1019 S. Elm Avenue
St. Louis, MO 63119
Phone: (314)962-8895
Fax: (314) 962-8895
www.lww.com
Booth #119

Lippincott Williams & Wilkins, a Wolters Kluwer Health company is a leading international publisher of medical books, journals, and electronic media. We proudly offer specialized publications and software for physicians, nurses, students and clinicians. Please visit our booth to browse our comprehensive product line.

MedTrak
10437 Innovation Drive, Suite 141
Milwaukee, WI 53226
Phone: (414)731-7150
Fax: (414)731-7150
www.medtrak.co
Booth #217

MedTrak provides patient handling systems for multi-modality suites including intra-operative MRI's, hybrid OR's, MR/ANGIO and image-guided radiation therapy suites. MedTrak's systems simplify the surgery/imaging/therapy transitions, facilitating integration of the independent rooms within the suite for the neurosurgical, neurovascular, cardiovascular and radiation oncology specialties.

Medtronic, Inc.
710 Medtronic Parkway
Minneapolis, MN 55432
Phone: (800)328-2518
Fax: (763)505-0450
www.medtronic.com
Booth #201

At Medtronic, we're committed to Innovating for life by pushing the boundaries of medical technology and changing the way the world treats chronic disease. To do that, we're thinking beyond products and beyond the status quo - to continually find more ways to help people live better, longer. Please visit Booth #201 to learn more.

EXHIBITOR LISTING AS OCTOBER 23, 2012

NICO Corporation
9190 Priority Way West Drive, Suite 203
Indianapolis, IN 46240
Phone: (317)660-7118
Fax: (317)682-0305
www.niconeuro.com
Booth #219

NICO Corporation is progressing minimally invasive corridor neurosurgery by creating instruments that allow for safe tumor and cyst removal through smaller openings. This provides neurosurgeons opportunities for less brain retraction, shorter total resection time, and precise control to achieve a more effective gross total resection. NICO's products offer the potential for less surgical trauma for patients, shorter hospital stays, better clinical outcomes, and improved clinical experiences.

Piezosurgery Incorporated
750 Communications Parkway
Columbus, OH 43214
Phone: (614)459-4922
Fax: (614)459-4981
www.piezosurgery.us
Booth #108

Piezosurgery® Medical by Mectron is an ultrasonic surgical system specifically designed for: osteotomy, osteoplasty, and drilling in a variety of surgical applications. The device is unique as it is designed to cut bone and the cutting action will not cut soft tissues such as dura mater.

Pro Med Instruments Inc.
4529 SE 16th Place, Suite 101
Cape Coral, FL 33904
Phone: (239)369-2310
Fax: (239)369-2370
www.headrest.de
Booth #104

PMI designs and manufactures the largest selection of cranial stabilization and brain retractor systems for neurosurgery, including the DORO® Multi-Purpose Skull Clamp, designed for pediatic application. PMI premiers a new skull clamp, the Navigation-Ready DORO® QR3 designed for faster set-up, integrated interfaces, built-in navigation adaptor and superior stability. Other innovations: Autoclavable Headrest Systems and FDA-cleared MRI-safe Radiolucent Headrest System. World's First Adjustable NON-STICK Bipolar Forceps.

RosmanSearch, Inc.
30799 Pinetree Road, Suite 250
Pepper Pike, OH 44124
Phone: (216)287-2302
Fax: (216)803-6672
www.rosmansearch.com
Booth #100

RosmanSearch is a dual-specialty, truly expert, high integrity neurosurgical and neurology recruiting service you can trust. We specialize exclusively in neuro permanent placement, and our neurosurgical recruitment expertise and methodology is truly unique.

Sacred Heart Health Systems
5151 N 9th Avenue
Pensacola, FL 32504
Phone: (850)416-1101
Fax: (850)416-1147
www.sacred-heart.org
Booth #106

Sacred Heart Health System is a member of Ascension Health, the nation's largest Catholic, non-profit health system. The hub of the Health System is a 466-bed acute care facility which includes Sacred Heart Hospital in Pensacola, Sacred Heart Children's Hospital and Sacred Heart Women's Hospital. Sacred Heart Health system is also comprised of Sacred Heart Hospital on the Emerald Coast, just east of Destin, FL and Sacred Heart Hospital on the Gulf, in Port St. Joe, FL.

Sonowand
11660 Alpharetta Highway; Suite 460
Roswell, GA 30076
Phone: (678)395-6849
Fax: (678)615-7610
www.sonowand.com
Booth #118

SonoWand Invite is a unique, 3D ultrasound-based intraoperative imaging system for neuronavigation. In addition to importing MR/CT images for preoperative planning, the surgeon can quickly and easily generate a new 3D navigation map that more accurately reflects the true anatomy position at any time during the procedure thus eliminating the problem of "brain-shift."

Sophysa USA, Inc.
303 S. Main Street
Crown Point, IN 46307
Phone: (219)663-7711
Fax: (219)663-7741
www.sophysa.com
Booth #114

Sophysa is focused on the design and manufacture of innovative CSF Management technologies and solutions. Sophysa's pioneering research and development continues to expand the reach of the global neurosurgical community, focusing on Hydrocephalus, and related disorders of CSF dynamics.

Stryker Craniomaxillofacial
750 Trade Center Way, Suite 200
Portage, MI 49002
Phone: (888)551-6092
Fax: (888)551-6092
www.stryker.com
Booth #110

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The AANS/CNS Section on Pediatric Neurological Surgery wishes to thank the following companies for their generous support of this year's Annual Meeting.

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PROGRAM AT- A- GLANCE

	TIME	EVENT	LOCATION
TUESDAY November 27	6:45 AM-7:00 PM	Registration	Ballroom Foyer
	8:00 AM-4:00 PM	Mid-Level Practitioner's Seminar	Regency Ballroom AB
	9:00 AM-4:00 PM	Practical Clinic: Instrumentation of the Pediatric Spine	Practical Anatomy & Surgical Education Lab (PASE)
	6:00-7:30 PM	Opening Reception	Grand Hall (lobby)
WEDNESDAY November 28	6:15 AM-5:00 PM	Registration	Ballroom Foyer
	6:45-7:45 AM	Breakfast Seminar: Contract Negotiation with Hospitals and Insurers	Illinois/New York Central
	7:15-8:00 AM	Continental Breakfast in Exhibit Hall	Grand Ballroom
	7:15 AM-5:30 PM	Exhibit Hall Open & E-Poster Viewing	Grand Ballroom
	8:00 AM-12:00 PM	Plenary & Scientific Sessions	Regency Ballroom
	9:50-10:15 AM	Beverage Break in Exhibit Hall	Grand Ballroom
	12:00-1:00 PM	Lunch in Exhibit Hall	Grand Ballroom
	1:00-4:30 PM	Scientific Sessions	Regency Ballroom
	2:45-3:15 PM	Beverage Break in Exhibit Hall	Grand Ballroom
	4:30-5:30 PM	Wine/Cheese Reception in Exhibit Hall	Grand Ballroom
THURSDAY November 29	6:15 AM-5:00 PM	Registration	Ballroom Foyer
	6:45-7:45 AM	Breakfast Seminar: Private Practice vs. Academic Pediatric Neurosurgery	Illinois/New York Central
	7:15-8:00 AM	Continental Breakfast in Exhibit Hall	Grand Ballroom
	7:15 AM-3:00 PM	Exhibit Hall Open & E-Poster Viewing	Grand Ballroom
	8:00 AM-12:00 PM	Plenary & Scientific Sessions	Regency Ballroom
	9:45-10:15 AM	Beverage Break in Exhibit Hall	Grand Ballroom
	12:00-1:00 PM	Lunch in Exhibit Hall	Grand Ballroom
	1:00-4:30 PM	Scientific Sessions	Regency Ballroom
	2:30-3:00 PM	Beverage Break in Exhibit Hall	Grand Ballroom
	4:30-4:45 PM	Annual Business Meeting	Regency Ballroom
	4:45-5:30 PM	Meet the Leadership Reception–For Residents, Fellows and Medical Students	The Depot
	6:00-9:30 PM	Brewery Night	Anheuser-Busch Brewery
FRIDAY November 30	6:15 AM-11:00 AM	Registration	Ballroom Foyer
	6:45-7:45 AM	Breakfast Seminar: Managing Burnout/Stress and Understanding Quality/Value	Illinois/New York Central
	7:15-8:00 AM	Continental Breakfast in Exhibit Hall	Grand Ballroom
	7:15-10:25 AM	Exhibit Hall Open & E-Poster Viewing	Grand Ballroom
	8:00-11:30 AM	Plenary & Scientific Sessions	Regency Ballroom
	9:55-10:25 AM	Beverage Break in Exhibit Hall	Grand Ballroom
	12:00-4:00 PM	Practical Clinic: Neuroendoscopy in the Pediatric Patient	Practical Anatomy & Surgical Education Lab (PASE)

SPEAKER DISCLOSURE INFORMATION

The AANS and the AANS/CNS Section on Pediatric Neurological Surgery control the content and production of the CME activity and attempt 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), faculty, abstract reviewers, paper presenters/authors, planning committee members, staff and any others involved in planning the educational content and the significant others of those mentioned must disclose any relationship they or their co-authors have with commercial interests which may be related to their content. The ACCME defines "relevant financial relationships" as financial relationships in any amount occurring within the past 12 months that create a conflict of interest.

As required by the American Nurses Credentialing Center's Accreditation Program, we would like to make you aware of all potential conflicts of interest(s). All speakers have agreed to present fairly and without bias. All sessions will be monitored to ensure that conflict does not arise.

Relationship refers to receipt of royalties, consultant, funding by research grant, receiving honoraria for educational services elsewhere, or any other relationship to a commercial interest that provides sufficient reason for disclosure.

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

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Ricky H. Wong, MD
Chester Kossman Yarbrough, MD
Scott Zuckerman, MD

* Indicates member of the planning committee

MID-LEVEL PRACTITIONER'S SEMINAR

TUESDAY, NOVEMBER 27

8:00 AM – 4:00 PM
Regency Ballroom AB

The goal of the Mid-Level Practitioner's Seminar is to address the challenges of multidisciplinary approaches and neurosurgical care in outpatient settings. This seminar will provide presentations from a number of perspectives addressing pediatric trauma and critical care, neuroanatomy and neurosurgical disorder topics. To successfully complete this course, you must be in attendance for the entire event and submit a completed course evaluation at the conclusion of the event. Lunch is provided.

Learning Ojectives:

- Describe the appropriate outpatient evaluation for lesions likely to affect the hypothalamic pituitary axis
- Describe the current state-of-the-field for the evaluation and treatment of spasticity related to cerebral palsy
- Describe diagnostic techniques for non-accidental trauma and resources to facilitate care
- Differentiate surgical and non-surgical causes of abnormal head shape.
- Review state-of-the-art outpatient evaluation methods for common neurosurgical problems
- Discuss technical considerations for the treatment of hydrocephalus
- Recognize the emergence of multidisciplinary approaches to treatment of traumatic brain injury
- Recognize the impact of multidisciplinary approaches on patient care
- Construct management plans for patients with traumatic cervical injuries
- Construct management plans for patients with ICP monitors, EVDs and shunts
- Recognize the role of evidence-based nurse driven research in pediatric neurosurgery
- Explain and apply emerging MRI tolls for the evaluation of neurosurgical conditions

8:00 – 8:15 AM
Welcome And Introduction
David Delmar Limbrick, MD, PhD

8:15 – 8:45 AM
Endocrine Evaluation of Sellar And Suprasellar Lesions
Abby Hollander, MD

8:45 – 9:15 AM
Multimodal Approaches For Cerebral Palsy
Jan Brunstrom-Hernandez, MD

9:15 – 9:45 AM
Improving Care of The Child With Spina Bifida: The Multidisciplinary Approach
Philipp R. Aldana, MD

9:45 – 10:15 AM
Evidence-Based Practice: The Influence And Impact of Nursing Research
Chevis Shannon, DrPH
E. Haley Vance, MSN, CPNP

10:15 – 10:30 AM
Beverage Break

10:30 – 11:00 AM
Vascular Abnormalities in The Infant And Child
Edward Robert Smith, MD

11:00 – 11:30 AM
Evaluating Infant Head Shape: Operative And Non-Operative Cases
Amy Lee, MD

11:30 AM – 12:00 PM
Technical Considerations in Hydrocephalus Treatment: Hardware Choice And Endoscopy
David Delmar Limbrick, MD, PhD

12:00 – 1:00 PM
Lunch

1:00 – 1:30 PM
Non-Accidental Trauma: Medical And Social Issues
Robert Paschall, MD

1:30 – 2:00 PM
Cervical Spine Injuries: Minor to Major
Jeffrey R. Leonard, MD

2:00 – 2:30 PM
Troubleshooting EVDs And ICP Monitors
Timothy W. Vogel, MD

2:30 – 3:00 PM
Critical Care Issues in The Management of The Child With Traumatic Brain Injury
Jose Pineda, MD

3:00 – 3:15 PM
Beverage Break

3:15 – 4:00 PM
MRI Fundamentals For The Brain And Spine
Josh Shimony, MD

PROGRAM SCHEDULE

TUESDAY, NOVEMBER 27

6:45 AM – 7:00 PM
Registration
Ballroom Foyer

7:00 – 11:00 AM
ABPNS Board Meeting
Missouri/Pacific

8:00 AM – 4:00 PM
Mid-Level Practitioner's Seminar
Regency Ballroom AB

PRACTICAL CLINIC

Instrumentation of the Pediatric Spine
Practical Anatomy & Surgical Education Lab (PASE)

9:00 AM – 4:00 PM
Transportation, Continental Breakfast and Lunch included.
Bus to depart from hotel at 8:30 AM

The purpose of this course will be to present an overview of instrumentation of the pediatric spine. Hands on workshops will allow participants to practice cranial junction instrumentation, lateral mass screw, anterior corpectomies and plating and pedicle screw placement for both deformity and trauma. The course will also be flexible to allow participants to focus on particular areas of interest in pediatric spine.

Faculty
Richard C. E. Anderson, MD
Douglas L. Brockmeyer, MD
James M. Johnston Jr., MD
Alexander K. Powers, MD

Attendees will receive a maximum of 6.5 *AMA PRA Category 1 Credits*™ for this practical clinic.

12:00 – 5:00 PM
Executive Committee Meeting
Illinois/New York Central

4:00 – 6:00 PM
Speaker Ready Room
The Depot Room

5:00 – 5:30 PM
Education Committee
Illinois/New York Central

6:00 – 7:30 PM
Opening Reception
Grand Hall (lobby)
Dress is business attire

WEDNESDAY, NOVEMBER 28

6:15 AM – 5:00 PM
Registration
Ballroom Foyer

6:45 – 7:45 AM
Breakfast Seminar: Contract Negotiation with Hospitals and Insurers
Illinois/New York Central Rooms

Presenters will discuss how to keep the upper hand when negotiating with hospital administrators as well as providing advice on how to be an advocate for your patients when negotiating with insurance companies and other payers.

Panelists
Frederick A. Boop, MD
David F. Jimenez, MD

Attendees will receive a maximum of 1 *AMA PRA Category 1 Credits*™ for each Breakfast Seminar.

7:00 AM – 4:00 PM
Speaker Ready Room
The Depot Room

7:15 – 8:00 AM
Continental Breakfast in Exhibit Hall
Grand Ballroom

7:15 AM – 5:30 PM
Exhibit Hall Open & E-Poster Viewing
Grand Ballroom

8:00 – 8:05 AM
Welcome and Opening Remarks
Regency Ballroom
Alan R. Cohen, MD

PROGRAM SCHEDULE

Please Note: All Hydrocephalus and Shulman Award Candidates are indicated with **

8:05 – 9:05 AM

SCIENTIFIC SESSION I – SAFETY, QUALITY & OUTCOMES

Moderators
Catherine Anne Mazzola, MD
Mark R. Proctor, MD

8:05 – 8:13 AM
1. Evaluating Infection Trends in Pediatric Neurosurgical Patients: A Multidisciplinary Process Improvement Initiative
Chevis Shannon, DrPH; Kyle Aune; Steven Veselsky; Anastasia Arynchyna; Amita Bey; John Wellons, MD, MPH (Birmingham, AL)

8:13 – 8:21 AM
2. Establishing ImPACT Norms For The Learning Disabled Following Sports-Related Concussion: A Neglected Population
Scott Zuckerman, MD; Young Lee, BS; Mitchell Odom, BS; Gary Solomon, PhD; Allen Sills, MD (Nashville, TN)

8:21 – 8:29 AM
3. Establishment of a Multidisciplinary Concussion Program: Impact of Standardization on Patient Care And Resource Utilization
James M. Johnston Jr., MD; Steven Brown, BA; Sara Wilkins, BA; Michael Falola, MD, MPH; Marshall Crowther, MD; Kimberly Gran, MD; Chevis Shannon, PhD (Birmingham, AL)

8:29 – 8:37 AM
4. Review of Complications After Elective Craniotomy: Does my Patient Need to go to The ICU?
Ashutosh Singhal, MD, FRCSC; John Kerr, BS (Vancouver, Canada)

8:37 – 8:45 AM
5. Detectibility of Implanted Neuropatties on Intra-Operative Radiographs Assessed in a Cadaver Model
David Douglas Cochrane, MD; Thomas Lou, BS; John Mawson, MD; Robert Almack; Apryil Noga (Vancouver, Canada)

8:45 – 8:53 AM
6. A Comparison of Costs Associated With Endoscope-Assisted Craniectomy Vs. Open Cranial Vault Repair For Infants With Sagittal Synostosis
Timothy W. Vogel, MD; Albert Woo, MD; Alex Kane, MD; Kamlesh Patel, MD; Sybill Naidoo, NP; Matthew Smyth, MD (St. Louis, MO)

8:53 – 9:01 AM
7. Creating Evidence-Based Recommendations For The Treatment of Children With Hydrocephalus
Ann Marie Flannery, MD; Catherine Mazzola, MD; Paul Klimo, MD; Benjamin Warf, MD; Mandeep Tamber, MD; Jay Rivas-Cambrin, MD; David Limbrick, MD; Joanna Kemp, MD; Asim Choudhri, MD; Tina Duhaime, MD; Lissa Baird, MD; Dimitios Nikas, MD; Kurt Auguste; Mark Van Poppel, MD; Laura Raymond (St. Louis, MO)

9:01 – 9:05 AM
8. Pedsneurosurgery.org: A New Beginning
Richard C. E. Anderson, MD; Jeffrey Leonard, MD; Ann Ritter, MD (New York, NY)

9:05 – 9:50 AM
Clinical Symposia: Surgical Treatment of Spasticity

Moderator
Alan R. Cohen, MD

Panelists
Bruce A. Kaufman, MD
Tae Sung Park, MD

9:50 – 10:15 AM
Beverage Break in Exhibit Hall
Grand Ballroom

10:15 – 11:11 AM

SCIENTIFIC SESSION II – FUNCTIONAL/ SPASTICITY

Moderators
Philipp R. Aldana, MD
Elizabeth C. Tyler-Kabara, MD, PhD

10:15 – 10:23 AM
9. Occipital Nerve Decompression Improves Peds QOL Scores in Chronic Daily Headache**
Sohum K. Desai, MD; Sudhakar Vadivelu, DO; Gabriel Brooks, PhD; Deanna Duggan; Robert Dauser, MD; Andrew Jea, MD; William Whitehead, MD; Thomas Luerssen, MD; Robert Bollo, MD; Diana Lebron, MD; Daniel Curry, MD (Galveston, TX)

10:23 – 10:31 AM
10. The Impact of a Novel Analgesia Protocol on Children Undergoing Selective Dorsal Rhizotomy
Robert Moore, MD; Charles Schrock, MD; Rani Sunder, MD; Tracy Wester, MD; Katherine Keech, MD; James Serot, MD; Sonia Shahrawat, MD; Sydney Nykiel, DO; T. Park, MD (St. Louis, MO)

PROGRAM SCHEDULE

10:31 – 10:39 AM
11. Risk Factors For Baclofen Pump Infections: A Multivariate Analysis**
Heather Stevens Spader, MD; Robert Bollo, MD; Judy Gooch, MD; Marion Walker, MD; Jay Riva-Cambrin, MD (Providence, RI)

10:39 – 10:47 AM
12. Deep Brain Stimulation to Treat Dystonia in a Transgenic Mouse Model of Rett Syndrome: Technical Description
Daniel J. Curry, MD; Akash Patel, MD; Jianrong Tang, MD; Zhengyu Wu; Javier Mata, MD; Huda Zoghbi, MD; Kirsten Ure, PhD (Houston, TX)

10:47 – 10:55 AM
13. Effect of Deep Brain Stimulation on Dystonic Cerebral Palsy in Children
Joseph Ryan Keen, DO; Allison Przekop, DO; Joffre Olaya, MD; Frank Hsu, MD, PhD; Alexander Zouros, MD (Loma Linda, CA)

10:55 – 11:03 AM
14. Impact of Hydrocephalus, Birth Weight, And Epilepsy on Intellectual Ability in Cerebral Palsy**
Meysam Ali Kebriaei, MD; Ana Arenivas, PhD; Matthew Gary, MD; Kentrell Burks, MD; Donald Bearden, MS; Thomas Burns, PhD; Joshua Chern, MD, PhD (Atlanta, GA)

11:03 – 11:11 AM
15. Attempted Bladder Reinnervation in Spinal Cord Injury: Clinical, Electrophysiologic And Histologic Outcome After The Xiao Procedure
Gerald F. Tuite Jr., MD; Bruce Storrs, MD; Yves Homsy, MD; Sarah Gaskill, MD; Ethan Polsky, MD; Margaret Reilly, BS; Steven Winesett, MD; Luis Rodriguez, MD; Carolyn Carey, MD; Sharon Perlman, MD; Lisa Tetreault, RN (St. Petersburg, FL)

11:11 AM – 12:00 PM
RAIMONDI LECTURE
Rosemary Gibson, MSc
Where Are We Headed: Health Care And America's Economic Future

12:00 – 1:00 PM
Lunch in Exhibit Hall
Grand Ballroom

1:00 – 2:20 PM
SCIENTIFIC SESSION III – EPILEPSY
Moderators
Frederick A. Boop, MD
Nicholas M. Wetjen, MD

1:00 – 1:08 PM
16. Disruption of Rolandic Gamma-Band Functional Connectivity by Seizures is Associated With Motor Impairments in Children With Epilepsy**
George M. Ibrahim, MD; Tomoyuki Akiyama, MD, PhD; Ayako Ochi, MD, PhD; Hiroshi Otsubo, MD; Mary Lou Smith, PhD; Margot Taylor, PhD; Elizabeth Donner, MD; James Rutka, MD, PhD; O. Carter Snead, MD; Sam Doesburg, PhD (Toronto, Canada)

1:08 – 1:16 PM
17. Volumetric CT Analysis as a Predictor of Seizure Outcome Following Temporal Lobectomy
Steven J. Schiff, MD, PhD; Jason Mandell, MS; Kenneth Hill, MD; Dan Nguyen, MD; Kevin Moser, MD; Robert Harbaugh, MD; James McInerney, MD; Bryan Kaaya; Derek Johnson, BS; Warren Boling, MD; Benjamin Warf, MD; Andrew Webb, PhD (University Park, PA)

1:16 – 1:24 PM
18. Seizure Outcomes Following Stereoelectroencephalography-Guided Resective Epilepsy Surgery in Children: A Longitudinal Analysis
Aria Fallah, MD; George Ibrahim, MD; Sumeet Vadera, MD; Jeffrey Mullin, MD; Jorge Gonzalez-Martinez, MD, PhD (Toronto, Canada)

1:24 – 1:32 PM
19. Surgical Outcome And Prognostic Factors in Children With Medically Intractable Epilepsy Caused by Focal Cortical Dysplasia
Brent Randle O'Neill, MD; Andrew White, MD; Pramote Laoprasert, MD; Michael Handler, MD (Aurora, CO)

1:32 – 1:40 PM
20. Navigating Eloquent Cortex: Combined Utility of Neuroimaging, Neuromonitoring And Cortical Mapping in Rolandic Epilepsy Surgery
Mustafa Moh'D Y. Nadi, MD; George Ibrahim, MD; Samuel Strantzas; Elizabeth Pang; James Drake, MD, MSC; James Rutka, MD, PhD (Toronto, Canada)

PROGRAM SCHEDULE

1:40 – 1:48 PM
21. Surgery For Intractable Epilepsy Due to Unilateral Brain Disease: A Retrospective Study Comparing Hemispherectomy Techniques
Subash Lohani, MD; Anna Pinto, MD; Ann Bergin, MD; Blaise Bourgeois, MD; Peter Black; Sanjay Prabhu, MD; Joseph Madsen, MD; Masanori Takeoka, MD; Annapurna Poduri (Boston, MA)

1:48 – 1:56 PM
22. MRI Guided Stereotactic Laser Thermal Ablation Technique in Epilepsy Surgery Our Initial Experience
Parthasarathi Chamiraju, MD; Sanjiv Bhatia, MD; John Ragheb, MD; Santiago Medina, MD, MPH; Nolan Altman, MD; Esperanza Pacheco, MD; Ian Miller, MD (Miami, FL)

1:56 – 2:04 PM
23. Predictors of Seizure Outcomes in Children With Tuberous Sclerosis Complex And Intractable Epilepsy Undergoing Resective Epilepsy Surgery: An Individual Participant Data Meta-Analysis**
Aria Fallah, MD; Gordon Guyatt, MD, MSC; O. Carter Snead III, MD; Shanil Ebrahim; George Ibrahim, MD; Alireza Mansouri, MD; Deven Reddy, MD; Stephen Walter, PhD; Abhaya Kulkarni, MD, PhD; Mohit Bhandari, MD, PhD; Laura Banfield, MS; Neera Bhatnagar; Shuli Liang, MD, PhD; Federica Teutonico, MD; Jianxiang Liao, MD, PhD; James Rutka, MD, PhD (Toronto, Canada)

2:04 – 2:12 PM
24. From Two Surgeries to One: Advanced Neuroimaging Reduces Invasive Monitoring in Pediatric Epilepsy Surgery
Pankaj Kumar Agarwalla, MD; Elizabeth Thiele, MD, PhD; Ronald Thibert, MD; Catherine Chu-Shore, MD; Bradley Buchbinder, MD; Steven Stufflebeam, MD; Paul Caruso, MD; Mirela Simon, MD; Ann-Christine Duhaime, MD (Boston, MA)

2:12 – 2:20 PM
25. Functional Lesionectomy: A Minimally Resective Strategy Effective in Children With MRI-Negative, Intractable Epilepsy
John Ragheb, MD; Sanjiv Bhatia, MD; Ann Hyslop, MD; Ian Miller, MD; Prasanna Jayakar, MD (Miami, FL)

2:20 – 2:45 PM
QI/NSQIP/NPA Update
Liliana C. Goumnerova, MD

2:45 – 3:15 PM
Beverage Break in Exhibit Hall
Grand Ballroom

3:15 – 4:27 PM
SCIENTIFIC SESSION IV – VASCULAR/ CRANIOSYNOSTOSIS

Moderators
James M. Johnston Jr., MD
Edward Robert Smith, MD

3:15 – 3:23 PM
26. Calvarial Thickness And Diploic Space Development in Children With Sagittal Synostosis Assessed by Computed Tomography
Trina Ghosh; Gary Skolnick, BA; Hank Sun, BA; Kamlesh Patel, MD; Matthew Smyth, MD; Albert Woo, MD (Kansas City, MO)

3:23 – 3:31 PM
27. Less-Invasive Pedicled Omental-Cranial Transposition in Pediatric Patients With Moyamoya Disease And Failed Prior Revascularization
Kevin Z. J. Chao, MD; Ramon Navarro, MD; Peter Gooderham, MD; Matias Bruzoni, MD; Sanjeev Dutta, MD; Gary Steinberg, MD, PhD (Palo Alto, CA)

3:31 – 3:39 PM
28. Intra And Inter-Rater Reliability of The Pediatric AVM Compactness Score
Fabio Frisoli; Shih-Shan Lang, MD; Arastoo Vossough, MD, PhD; Anne Marie Cahill, MD; Hisham Dahmoush, MD; Gregory Heuer, MD, PhD; Phillip Storm, MD; Lauren Beslow, MD (Philadelphia, PA)

3:39 – 3:47 PM
29. Skull Growth and Cranial Vault Volumes in Sagittal Synostosis
Rahel Ghenbot; Gary Skolnick, BS; Kamlesh Patel, MD; Sybill Naidoo, NP; Matthew Smyth, MD; Albert Woo, MD

3:47 – 3:55 PM
30. Anterior Fontanelle Size And Closure in Full Term Children Based on Head Computed Tomography**
Jonathan A. Pindrik, MD; Boram Ji, BS; Courtney Pendleton, MD; Edward Ahn, MD (Baltimore, MD)

3:55 – 4:03 PM
31. Pediatric Moya-Moya: Surgical Variation, Seizure Outcomes, And Angiographic Followup**
Luke Tomycz, MD; Ato Wallace, BS; Laila Haasan-Malani; Peter Morone, MD; Robert Singer, MD; Robert Mericle, MD (Nashville, TN)

PROGRAM SCHEDULE

4:03 – 4:11 PM
32. Features of Cerebral Arteriovenous Malformations in Children
Andrei B. Talanov, MD, PhD (Ivanovo, Russian Federation)

4:11 – 4:19 PM
33. Multi-Concentric Osteotomy For Correction of Cranial Deformities: Case Series And Follow-up
Jennifer Gentry Savage, MD; Micam Tullous, MD; Patricia Mancuso, MD (San Antonio, TX)

4:19 – 4:27 PM
34. The Safety of The Intraoperative Sacrifice of The Deep Cerebral Veins
J. McComb, MD; Laurence Davidson, MD (National Naval Medical Ctr, MD)

4:27 – 4:30 PM
Announcements

4:30 – 5:30 PM
Wine and Cheese Reception in Exhibit Hall
Grand Ballroom

THURSDAY, NOVEMBER 29

6:15 AM – 5:00 PM
Registration
Ballroom Foyer

6:45 – 7:45 AM
Breakfast Seminar: Private Practice vs. Academic Pediatric Neurosurgery
Illinois/New York Central Rooms

Developing a successful private practice in pediatric neurological surgery is challenging…but possible. Building a successful academic career in pediatric neurological surgery requires different strategies. Come and find out answers to your questions.

Panelists
Catherine Anne Mazzola, MD
Nathan R. Selden, MD, PhD

Attendees will receive a maximum of 1 *AMA PRA Category 1 Credits*™ for each Breakfast Seminar.

7:00 AM – 4:00 PM
Speaker Ready Room
The Depot

7:15 – 8:00 AM
Continental Breakfast in Exhibit Hall
Grand Ballroom

7:15 AM – 3:00 PM
Exhibit Hall Open & E-Poster Viewing
Grand Ballroom

8:00 – 8:05 AM
Announcements
Regency Ballroom

8:05 – 9:09 AM
SCIENTIFIC SESSION V – NEOPLASM I

Moderators
Samuel R. Browd, MD, PhD
Gerald A. Grant, MD

8:05 – 8:13 AM
35. Protein Profiling of Diffuse Intrinsic Pontine Glioma Tumor Tissue: A Comparative Analysis*
WITHDRAWN
Amanda Muhs Sarnoski, MD; Kendall Snyder; Jordan Hall; Madhuri Kambhampati; Sridevi Yadavilli, PhD; Jennifer Perez, BA; Suresh Magge, MD; Javad Nazarian, PhD (Arlington, VA)

8:13 – 8:21 AM
36. BRAF-Targeted Therapeutics in Low-Grade Gliomas**
Shih-Shan Lang, MD; Angela Sievert, MD, MPH; Katie Boucher, BS; Phillip Storm, MD; Adam Resnick, PhD (Philadelphia, PA)

8:21 – 8:29 AM
37. Neo-Adjuvant Chemotherapy Improves Survival for Infants With Ependymoma: Preliminary Results of St. Jude Young Children (SJYC07) Trial
Frederick A. Boop, MD; Paul Klimo, MD, MPH; Karen Wright, MD; Amar Gajjar, MD; T. Hassall, MD; D Bowers, MD; J. Crawford, MD; Atman Pai, MD; Thomas Merchant, DO; David Ellison, MD; Frederick Boop, MD (Memphis, TN)

8:29 – 8:37 AM
38. Role of Bone Marrow Derived Cells in The Tumor Microenvironment of Medulloblastoma**
Caitlin Elizabeth Hoffman, MD; Karen Badal, MD; Prajwal Rajappa, MD; Yujie Huang, PhD; Jacqueline Bromberg, MD, PhD; David Lyden, MD, PhD; Jeffrey Greenfield, MD, PhD (New York, NY)

8:37 – 8:45 AM
39. Pseudoprogression of Low Grade Gliomas After Radiotherapy
Robert Partlow Naftel, MD; Melvin Deutsch, MD; Regina Jakacki, MD; Ian Pollack, MD (Pittsburgh, PA)

PROGRAM SCHEDULE

8:45 – 8:53 AM
40. Systematic Review of The Results of Surgery And Radiotherapy on Tumor Control For Pediatric Craniopharyngioma**
Aaron John Clark, MD; Tene Cage, MD; Derick Aranda, MD; Andrew Parsa, MD, PhD; Peter Sun, MD; Kurtis Auguste, MD; Nalin Gupta, MD, PhD (San Francisco, CA)

8:53 – 9:01 AM
41. Effect of Surgical Debulking on Post-Operative Cerebellar Mutism
Anthony Myint; Yasser Jeelani, MD; Jessica Ashford, MS; Stephanie Da Silva, BA; J. Gordon McComb, MD; Mark Krieger, MD (San Marino, CA)

9:01 – 9:09 AM
42. Fluorescence-Guided Resection of Pediatric CNS Neoplasms With The Use of Novel, Saposin C-Dioleoylphosphatidylserine (Sapc-DOPS) Nanovesicles
Lauren Rose Ostling, MD; Xiaoyang Qi, PhD; Charles Stevenson, MD (Cincinnati, OH)

9:09 – 9:54 AM
Clinical Symposia: Update on Malignant Pediatric Bain Tumors

Moderator
Jeffrey R. Leonard, MD

Panelists
Ian F. Pollack, MD
Michael D. Taylor, MD, PhD

9:54 – 10:15 AM
Beverage Break in Exhibit Hall
Grand Ballroom

10:15 – 11:11 AM
SCIENTIFIC SESSION VI – NEOPLASM II

Moderators
Todd Cameron Hankinson, MD, MBA
Ian F. Pollack, MD

10:15 – 10:23 AM
43. Progression of Craniopharyngioma Following Conformal Radiation
Paul Klimo Jr., MD; Frederick Boop, MD; Kyle Gabrick, BS; Thomas Merchant, MD; Robert Sanford, MD (Memphis, TN)

10:23 – 10:31 AM
44. Evaluation of a New Staging System For Juvenile Nasopharyngeal Angiofibromas (JNA)
Kimberly Anne Foster, MD; Carl Snyderman, MD; Eric Wang, MD; Carlos Pinheiro, MD; H. Pant, MD; Juan Fernandez-Miranda, MD; Paul Gardner, MD; Elizabeth Tyler-Kabara, MD, PhD (Pittsburgh, PA)

10:31 – 10:39 AM
45. Decision Analysis of Treatment Options For Pediatric Craniopharyngiomas
Lawrence Daniels, MD; Zarina S. Ali, MD; Robert Bailey, MD; John Lee, MD; Phillip Storm, MD; Sherman Stein, MD; Gregory Heuer, MD, PhD (Philadelphia, PA)

10:39 – 10:47 AM
46. Pseudoprogression in The Pediatric Brain Tumors**
Chester Kossman Yarbrough, MD; Aravind Somasundaram, BS; Jeffrey Leonard, MD (St. Louis, MO)

10:47 – 10:55 AM
47. Does The Presence or Development of Hydrocephalus Affect The Prognosis For Diffuse Intrinsic Pontine Glioma?
Ifeanyi David Nwokeabia; John Grimm, MD; Ira Bowen, BA; Yasser Jeelani, MD; Sara Ghayouri; Stephanie Da Silva, MD; Mark Krieger, MD; J. Gordon McComb, MD (Washington, DC)

10:55 – 11:03 AM
48. Morbidity And Neurological Outcomes Following Repeat Surgical Resection of Pediatric Intramedullary Tumors**
Raheel Ahmed, MD; Arnold Menezes, MD (Iowa City, IA)

11:03 – 11:11 AM
49. Greater Extent of Resection Improves Progression-Free Survival in Children With Gangliogliomas: A Volumetric Analysis
Devon H. Haydon, MD; Jeffrey Leonard, MD (St. Louis, MO)

11:11 AM – 12:00 PM
AAP/SECTION ON NEUROLOGICAL SURGERY (SONS) SPECIAL LECTURE
Terrie E. Inder, MD
Advances in Improving Outcomes in the Newborn Brain

12:00 – 1:00 PM
Lunch in Exhibit Hall
Grand Ballroom

1:00 – 1:10 PM
Small Grant Research Awards
Mark M. Souweidane, MD
Gerald F. Tuite Jr., MD

PROGRAM SCHEDULE

1:10 – 2:30 PM
SCIENTIFIC SESSION VII – HYDROCEPHALUS I

Moderators
Bermans J. Iskandar, MD
Francesco T. Mangano, DO

1:10 – 1:18 PM
50. Quality Measures For The Management of Hydrocephalus: Concepts, Simulations, And Preliminary Field Testing
Joseph H. Piatt Jr., MD; Spencer Barton; Jeffrey Campbell, MD (Merion Station, PA)

1:18 – 1:26 PM
51. Fourth Ventricular Shunt Survival Comparing Parietal Stereotactic Endoscopic Transtentorial And Suboccipital Approaches**
Sarah Tamara Garber, MD; Frank Bishop, MD; Douglas Brockmeyer, MD; Jay Riva-Cambrin, MD (Salt Lake City, UT)

1:26 – 1:34 PM
52. Ventriculomegaly Diagnosed on Fetal MRI And The Risk of Post-Natal Hydrocephalus
Matthew Kole; Jennifer Williams, MD; Angel Krueger; Debora Ybarra; William Whitehead, MD; Christopher Cassady, MD; Robert Bollo, MD (Houston, TX)

1:34 – 1:42 PM
53. Abnormal Development of NG2+PDGFRα+ Neural Progenitor Cells Causes Neonatal Hydrocephalus
Timothy W. Vogel, MD; Calvin Carter, BA; Qihong Zhang, PhD; Tom Moninger, PhD; Dan Thedens, PhD; Kimberly Keppler-Noreuil, MD, PhD; Darryl Nishimura, PhD; Charles Searby, PhD; Kevin Bugge, BA; Arnold Menezes, MD; Val Sheffield, MD, PhD (St. Louis, MO)

1:42 – 1:50 PM
54. Decorin Reduces Ventriculomegaly And Subarachnoid Fibrosis in Juvenile Rats With Communicating Hydrocephalus
James P. (Pat) McAllister II, PhD; Hannah Botfield, MS; Anders Skjolding, MD; Ana Gonzalez, PhD; Osama Abdullah, MS; Martin Berry, PhD; Ann Logan, PhD (Salt Lake City, UT)

1:50 – 1:58 PM
55. Frontal Versus Parietal CSF Shunts And Shunt Survival, an HCRN Study
William E. Whitehead, MD, MPH; Abhaya Kulkarni, MD; Jay Riva-Cambrin, MD; John Wellons, MD; James Drake, MD; Thomas Luerssen, MD; Jerry Oakes, MD; Marion Walker, MD; John Kestle, MD (Houston, TX)

1:58 – 2:06 PM
56. The Risk Factors For And The Influence of Hydrocephalus on Neurological Outcome in Children Born With an Encephalocele
Stephanie Louise Da Silva; Yasser Jeelani, MD; Andrew Yousef; Mark Krieger, MD; J. Gordon McComb, MD (Los Angeles, CA)

2:06 – 2:14 PM
57. Limited Sequence Head CT Analysis For Children With Shunted Hydrocephalus**
Jonathan A. Pindrik, MD; Edward Ahn, MD; Aylin Tekes, MD; Thierry Huisman, MD (Baltimore, MD)

2:14 – 2:22 PM
58. Significant Shunt Obstruction Caused by Parenchymal Tissue Shearing During Ventricular Catheter Implantation**
Jayant Prasanna Menon, MD; Kathryn Olson; Jon Dunbar, BS (San Diego, CA)

2:22 – 2:30 PM
59. Role of Endoscopic Third Ventriculostomy And Choroid Plexus Coagulation in Post Hemorrhagic Hydrocephalus of Prematurity
Parthasarathi Chamiraju, MD; David Sandberg, MD; John Ragheb, MD; Sanjiv Bhatia, MD (Miami, FL)

2:30 – 3:00 PM
Beverage Break in Exhibit Hall
Grand Ballroom

3:00 – 3:10 PM
2011 NREF Young Clinician Investigator Award
Sheila Kumari Singh, MD

3:10 – 4:30 PM
SCIENTIFIC SESSION VIII – HYDROCEPHALUS II/MISCELLANEOUS

Moderators
Tord D. Alden, MD
Shenandoah Robinson, MD

3:10 – 3:18 PM
60. The Association Between Race And Malignant Shunt Failure
Robert Partlow Naftel, MD; Nicole Safiano, BS; Michael Falola, MD, MPH; Jeffrey Blount, MD; W Oakes, MD; John Wellons, MD, MPH (Pittsburgh, PA)

3:18 – 3:26 PM
61. Visual Findings in Children With Shunted Hydrocephalus
Julian J. Lin, MD; Lasun Oladeji, BA; Ahmad Issawi, MD; Lynn Lyle, RN (Peoria, IL)

PROGRAM SCHEDULE

3:26 – 3:34 PM
62. Role of Primary Cilia in Developing Chick Embryos
Takayuki Inagaki, MD; Gary Schoenwolf, PhD (Salt Lake City, UT)

3:34 – 3:42 PM
63. Ommaya Ventricular Reservoir Versus Ventriculosubgaleal Shunt For Posthemorrhagic Hydrocephalus: Infection Risks And Ventriculoperitoneal Shunt Rates
Joanna Wang, BA; Anubhav Gautam Amin; Vivek Mehta, MD; Benjamin Carson, MD; George Jallo, MD; Edward Ahn, MD (Baltimore, MD)

3:42 – 3:50 PM
64. Percutaneously-Placed Ventriculo-Atrial Shunts Versus Ventriculo-Peritoneal Shunts: Bringing Back an Old Technique
Tyler Amina; Robert Keating, MD; Ameet Chitale, MD; John Myseros, MD; Amanda Yaun, MD; Bhupender Yadav, MD; Suresh Magge, MD (Washington, DC)

3:50 – 3:58 PM
65. Cerebrospinal Fluid Levels of APP And NCAM-1 Correlate With Ventricular Size in Post-Hemorrhagic Ventricular Dilatation
David Delmar Limbrick, MD, PhD; Diego Morales, MS; Richard Holubkov, PhD; Haejun Ahn, BS; Deanna Mercer, BS; Terrie Inder, MD, PhD (St. Louis, MO)

3:58 – 4:06 PM
66. Erythropoietin Signaling Promotes Oligodendrocyte Development After Prenatal Hypoxic-Ischemic Brain Injury
Shenandoah Robinson, MD; Lauren Jantzie, PhD (Boston, MA)

4:06 – 4:14 PM
67. The Management of Torticollis in Infants And Children
Catherine Anne Mazzola, MD; Lauren Schwartz, MD; Tosan Livingstone, MD; Deborah Straka-DeMarco, PT; Tara Gleeson; Kaitlyn Mulhall, RN; Stuart Wiener, CPO, LPO (Morristown, NJ)

4:14 – 4:22 PM
68. Spinal Level of Myelomeningocele Lesion is a Contributing Factor in Posterior Fossa Volume, Intracranial Cerebellar Volume And Cerebellar Ectopia**
Kieron Sweeney; John Caird, MD; Taufiq Sattar; David Allcutt; Darach Crimmins (Donegal, Ireland)

4:22 – 4:30 PM
69. Endoscopic Third Ventriculostomy Decreases Ventriculo-Peritoneal Shunt Rate in Posterior Fossa Tumors**
Shih-Shan Lang, MD; Fabio Frisoli, BS; Gregory Heuer, MD, PhD; Phillip Storm, MD (Philadelphia, PA)

4:30 – 4:45 PM
Annual Business Meeting
Regency Ballroom

4:45 – 5:15 PM
SONS Business Meeting
Regency Ballroom

4:45 – 5:30 PM
Meet the Leadership Reception For Residents, Fellows And Medical Students
The Depot

BREWERY NIGHT AT ANHEUSER-BUSCH

6:00 – 9:30 PM
Evening includes transportation, dinner, beverages, brewery tour, and picture with the Clydesdales

Bus to depart from hotel at 5:45 PM
Dress is business casual for the evening

Special Guest: George Reisch, Brewmaster and Director of Brewmaster Outreach, Anheuser-Busch

PROGRAM SCHEDULE

FRIDAY, NOVEMBER 30

6:15 – 11:00 AM
Registration
Ballroom Foyer

6:45 – 7:45 AM
Breakfast Seminar: Managing Burnout/Stress and Understanding Quality/Value
Illinois/New York Central Rooms

Neurosurgeons need to manage burn out and stress. Learn how to perform with excellence as well as evaluate and assess your performance as a pediatric neurological surgeon using quality indicators.

Panelists
Liliana C. Goumnerova, MD
Paul Klimo Jr., MD

Attendees will receive a maximum of 1 *AMA PRA Category 1 Credits*™ for each Breakfast Seminar.

7:00 – 11:00 AM
Speaker Ready Room
The Depot

7:15 – 8:00 AM
Continental Breakfast in Exhibit Hall
Grand Ballroom

7:15 – 10:25 AM
Exhibit Hall Open & E-Poster Viewing
Grand Ballroom

8:00 – 9:04 AM
SCIENTIFIC SESSION IX – SPINE/TRAUMA

Moderators
Richard C. E. Anderson, MD
Kurtis Ian Auguste, MD

8:00 – 8:08 AM
70. Multicenter Immature Large Animal Brain Injury Treatment Trial: Neuroprotection With Cyclosporin A
Kristen Leigh Saliga; Susan Margulies, PhD; Todd Kilbaugh, MD; Beth Costine, PhD; Colin Smith, MD; Carter Dodge, MD; Sarah Sullivan, MS; Christopher Owen, MS; Sabrina Taylor, MS; Ann-Christine Duhaime, MD (Boston, MA)

8:08 – 8:16 AM
71. Gene Expression Patterns of CNS Growth And Regeneration at Various Developmental Stages And After Injury**
Elias B. Rizk, MD; Krista Stewart, BS; Sivan Meethal, PhD; Nithya Hariharan, MD; Bermans Iskandar, MD (Harrisburg, PA)

8:16 – 8:24 AM
72. CSF Complications Following Intradural Spinal Surgeries in Children
Victor Liu, BS; Paul Steinbok, MD(L); Chris Gillis, MD; Doug Cochrane, MD; Ash Singhal, MD, MSC (Vancouver, Canada)

8:24 – 8:32 AM
73. Effectiveness And Long Term Clinical Outcome of Conservative Treatment For Lumbar Spondylolysis in Children
Santoshi Shalini Indrakanti; Rory Murphy, MD; Deanna Mercer; Jeffrey Leonard, MD; David Limbrick, MD, PhD (Santa Rosa, CA)

8:32 – 8:40 AM
74. Occipital Condyle to Cervical Fixation in The Pediatric Population**
Libby Marie Kosnik-Infinger, MD, MPH; Steven Glazier, MD; Bruce Frankel, MD; Avery Buchholz, MD, MPH (Charleston, SC)

8:40 – 8:48 AM
75. Evaluation of Hemorrhagic Complications Associated With Perioperative Ketorolac Use in Pediatric Neurosurgery Patients
Todd Cameron Hankinson, MD, MBA; M. Richardson, MD; Nicholas Palmeri, BA; Sarah Williams; Michelle Torok, PhD; Michael Handler, MD (Aurora, CO)

8:48 – 8:56 AM
76. Defining Reasonable Medical Certainty in Child Abuse Court Cases
Mark S. Dias, MD; Benjamin Levi, MD; William Wenner, MD; Mark Iantosca, MD; Susan Boehmer, MS (Hershey, PA)

8:56 – 9:04 AM
77. Use of MRI-STIR Imaging in Pediatric Traumatic Cervical Spine Clearance
Steven Hwang, MD; Mark Henry; Katherine Scarlata; Amy Kalleen, BS; Alexis Chavez, BS; Ron Riesenburger, MD; James Kryzanski, MD; Leslie Rideout, RN; Amer Samdani, MD; (Boston, MA)

PROGRAM SCHEDULE

9:04 – 9:50 AM
Clinical Symposia: Controversies in the Management of Chiari and Syringomyelia

Moderator
Matthew D. Smyth, MD

Panelists
David Delmar Limbrick, MD, PhD
W. Jerry Oakes, MD

9:50 – 9:55 AM
2013 Toronto Meeting Preview

Meeting Co-Chairs
James M. Drake, MD, MSc
Abhaya Vivek Kulkarni, MD
James T. Rutka, MD, PhD

9:55 – 10:25 AM
Beverage Break in Exhibit Hall
Grand Ballroom

10:25 – 11:19 AM
SCIENTIFIC SESSION X – CHIARI/ CONGENITAL

Moderators
Ann Marie Flannery, MD
David P. Gruber, MD

10:25 – 10:33 AM
78. The Importance of a Radiographic Fatty Filum in The Diagnosis of Tethered Cord Syndrome**
Eric Michael Thompson, MD; Michael Strong, BS; Garth Warren, MD; Nathan Selden, MD, PhD (Portland, OR)

10:33 – 10:41 AM
79. Chiari I Malformation And Sports: Evaluating The Risk of Injury**
Jennifer Mae Strahle, MD; Regina Bower, MD; Bela Selzer, NP; Hugh Garton, MD; Karin Muraszko, MD; Nicholas Wetjen, MD; Cormac Maher, MD (Ann Arbor, MI)

10:41 – 10:49 AM
80. Chiari I Malformations: Institutional Experience of 158 Patients Reviewing Symptom Resolution Based on Operative Intervention
Renee M. Reynolds, MD; Keiko Weir; David Bauer, MD; Samuel Browd, MD, PhD; Richard Ellenbogen, MD (Seattle, WA)

10:49 – 10:57 AM
81. The Case For International Pediatric Neurosurgical Experiences: A Breakdown of US Resident Experiences With Pediatric Spinal Dysraphism Cases
Brandon G. Rocque, MD; Humphrey Okechi, MD; Kimberly Foster, MD; Luke Tomycz, MD; Jonathan Forbes, MD; Leland Albright, MD; Sandi Lam, MD (Madison, WI)

10:57 – 11:03 AM
82. Isolation of Neural Stem Cells From Myelomeningocele Placodes With Potent Oligodendrocyte Forming Ability
Samuel H. Cheshier, MD, PhD; Sharareh Gholamin, MD; Siddhartha Mitra, PhD; Chase Richard, BS; Michael Edwards, MD (Stanford, CA)

11:03 – 11:11 AM
83. The Distribution of Cerebellar Tonsil Height Defined by Age: Implications For Understanding Chiari Malformation
Cormac O. Maher, MD; Jennifer Strahle, MD; Hugh Garton, MD; Karin Muraszko, MD; Brandon Smith, BS (Ann Arbor, MI)

11:11 – 11:19 AM
84. Long Term Follow up in Tethered Spinal Cord Following Myelomeningocele Closure
Jeffrey P. Blount, MD, FAAP; Christi Boddiford, BA; Betsy Hopson, BA; Chevis Shannon, PhD (Birmingham, AL)

11:19 – 11:24 AM
Hydrocephalus and Shulman Awards
Recipients Announced

11:24 – 11:29 AM
Closing Remarks

PRACTICAL CLINIC

Neuroendoscopy in the Pediatric Patient
Practical Anatomy & Surgical Education Lab (PASE)

12:00-4:00 PM
Transportation and lunch are provided.
Bus to depart from hotel at 11:45 AM

The endoscopy course will focus on the intraventricular approaches for a third ventriculostomy, tumor resection as well as removal of colloid cysts. Experienced instructors will also discuss their complications and tehcniques for avoidance. Participants then will be able to practice these techniques in a hands-on lab.

Faculty
David Delmar Limbrick, MD, PhD
Mark M. Souweidane, MD
John C. Wellons III, MD

Attendees will receive a maximum of 3.5 *AMA PRA Category 1 Credits*™ for this practical clinic.

ORAL ABSTRACTS

Please Note: Hydrocephalus and Kenneth Shulman Award Candidates are indicated with **

1. EVALUATING INFECTION TRENDS IN PEDIATRIC NEUROSURGICAL PATIENTS: A MULTIDISCIPLINARY PROCESS IMPROVEMENT INITIATIVE

Chevis Shannon, DrPH; Kyle Aune; Steven Veselsky; Anastasia Arynchyna; Amita Bey; John Wellons, MD, MPH (Birmingham, AL)

INTRODUCTION: The purpose of this study was to identify potential risk factors associated with surgical site infections (SSI) and to implement process improvements that will lead to decreased incidence of infections in time.

METHODS: A multidisciplinary taskforce comprised of ten departments ranging from neurosurgery and infection control, to sterile processing and environmental services was established. The goal was to evaluate an increase in neurosurgical infections. The task force identified 67 variables of interest to assess. A retrospective chart review of all pediatric patients who underwent a neurosurgical procedure between the years 2009 and 2012 was conducted. Demographics, surgical data, unit and environmental factors and admission/discharge data were collected. Follow-up data was reviewed up to 6 months post-op to screen for infection.

RESULTS: 1,127 patients undergoing 2,282 neurosurgical procedures were evaluated. Infection prevalence was 12% (n=143). Number of procedures, number of visits per patient, and patient days in-house were all found to be statistically significant.

CONCLUSIONS: This study validates literature on SSI risk factors in the pediatric population, although several of our findings were relevant to policy changes within our institution. Meeting quarterly, our task force continues to discuss mitigating circumstances surrounding new infections and track data in order to evaluate long term efficacy of process changes.

2. ESTABLISHING IMPACT NORMS FOR THE LEARNING DISABLED FOLLOWING SPORTS-RELATED CONCUSSION: A NEGLECTED POPULATION

Scott Zuckerman, MD; Young Lee, BS; Mitchell Odom, BS; Gary Solomon, PhD; Allen Sills, MD (Nashville, TN)

INTRODUCTION: Up to 16% of US children aged 3-17 years have either Attention Deficit-spectrum Disorder (ADD) or a Learning Disability (LD). Sport-related concussions (SRC) among youth athletes represent a significant public health concern, and neurocognitive testing is a method to evaluate severity and recovery after SRC. Little normative Immediate Post-Concussion Assessment and Cognitive Testing (ImPACT) data exists for athletes with ADD/LD. The goal of our study is to assess baseline neurocognitive differences between ADD/LD vs. non-ADD/LD athletes and establish normative data for this neglected population.

METHODS: From August 2007 to March 2012, baseline neurocognitive testing using the ImPACT test battery was performed amongst 6,636 high school athletes. Of the total participants, 97 had LD only, 270 had ADD only, 55 had both ADD and LD. Average mean scores and standard deviations were calculated for each group to obtain norms. Multiple regression analysis was used to test if ADD/LD status significantly predicted participants' baseline neurocognitive scores.

RESULTS: In our multiple regression model, it was found that ADD significantly predicted Verbal Memory (β=-4.00, $p<0.001$), Visual Memory (β=-3.63, $p<0.001$), Visual Motor Speed (β=-1.63, $p<0.001$), and Reaction Time (β=0.015, $p=0.006$). LD significantly predicted Verbal Memory (β=-3.32, $p=0.001$), Visual Memory (β=-3.56, $p=0.002$), Visual Motor Speed (β=4.02, $p<0.001$), and Reaction Time (β=0.031, $p<0.001$). Means and standard deviations were calculated to provide normative values.

CONCLUSIONS: Athletes with ADD and/or LD have lower baseline ImPACT neurocognitive scores compared to athletes without ADD and LD. Normative neurocognitive data for these populations are provided.

3. ESTABLISHMENT OF A MULTIDISCIPLINARY CONCUSSION PROGRAM: IMPACT OF STANDARDIZATION ON PATIENT CARE AND RESOURCE UTILIZATION

James M. Johnston Jr., MD; Steven Brown, BA; Sara Wilkins, BA; Michael Falola, MD, MPH; Marshall Crowther, MD; Kimberly Gran, MD; Chevis Shannon, PhD (Birmingham, AL)

INTRODUCTION: Recent legislation and media reporting has heightened awareness of concussion in youth sports. Previous work by our group defined significant variation of care in management of children with concussion. We established a multidisciplinary concussion program with a uniform management protocol and emphasis on community outreach via traditional media sources and the Internet. This study evaluates the impact of standardization on patient care and resource utilization.

METHODS: This retrospective study included all patients younger than 18 years of age evaluated for sports-related concussion between 2007-2012. Emergency department (ED), sports medicine, and neurosurgery records were reviewed. Data included demographics, injury details, clinical course, SCAT2 scores, imaging, discharge instructions, and referral for specialty care. The cohort was analyzed comparing patients seen before and after standardization of care.

RESULTS: 589 patients, 270 pre (2007-2011) and 319 post (2011-2012) standardization, were identified. Statistically significant ($p<.0001$) differences were seen between the pre and post groups in multiple variables: there were more girls, more first time concussions, fewer initial presentations to the ED, more consistent administration of the SCAT2, and more consistent supervision of return to play after adoption of the protocol.

CONCLUSIONS: A combination of increased public awareness and legislation has led to a 500% increase in the number of youth athletes presenting for concussion evaluation at our center. Establishment of a multidisciplinary clinic with a standardized protocol has resulted in significantly decreased institutional resource utilization and more consistent concussion care for this growing patient population.

4. REVIEW OF COMPLICATIONS AFTER ELECTIVE CRANIOTOMY: DOES MY PATIENT NEED TO GO TO THE ICU?

Ashutosh Singhal, MD, FAANS, FRCSC; John Kerr, BS (Vancouver, Canada)

INTRODUCTION: Patients are routinely admitted to ICU after elective craniotomy. Although the factors predicting post-operative complications have been explored in adults, these factors are not fully characterized in children. The purpose of this study was to explore the nature and frequency of serious early post-operative complications requiring intensive care management.

METHODS: We conducted a retrospective review of patients <18 years old with elective cranial surgery at British Columbia's Children's Hospital from 2008-2011. Emergency procedures were excluded from this review. Study variables included patient demographics, clinical history, operative details, and early post-operative complications requiring intensive care management.

RESULTS: 76 patients were included in our review, of which 70 had an uneventful postoperative recovery, one had an early CSF leak (the diagnosis or management of which was not specifically enhanced by the ICU stay), and one required vasoactive drugs for hypertension. Amongst the 4 patients (5.3%) with serious early complications, 3 required urgent medical imaging for unexpected neurological deficits (1 post-operative hematoma, 1 persistent hydrocephalus, 1 unremarkable imaging exam in a slow to wake patient), and one patient required intubation/ventilation for an unexpected awakening delay. These 4 patients all had anesthetic times exceeding 450 minutes, and 3 had undergone posterior fossa tumor surgery.

CONCLUSIONS: This study suggests that children most at risk for early serious post-operative complications, including neurological and cardio-respiratory complications, are those with lengthy procedures, often involving the posterior fossa or brainstem. Patients with shorter procedures and those with supratentorial pathology might not require post-operative ICU monitoring.

ORAL ABSTRACTS

5. DETECTIBILITY OF IMPLANTED NEUROPATTIES ON INTRA-OPERATIVE RADIOGRAPHS ASSESSED IN A CADAVER MODEL

David Douglas Cochrane, MD, FAANS; Thomas Lou, BS; John Mawson, MD; Robert Almack; Apryil Noga (Vancouver, Canada)

INTRODUCTION: Neuropatties contain radiomarkers for x-ray detection. BC Children's Hospital and other institutions require intra-operative imaging to detect neuropatties when the surgical count is not reconciled. The FDA MAUDE database contains on-going reports suggesting that neuropatties may not be visualized on intraoperative images and therefore are at risk to be unintentionally retained foreign bodies.

METHODS: An adult cadaver was draped and dissected to simulate clinical scenarios. A circumferential craniotomy and occipital craniotomy, and laminectomy were performed to access the anterior cranial fossa (ACF), posterior cranial fossa (PCF), and the thoracic and lumbar extradural space. Randomized combinations of neuropatties in four sizes were placed in dissected regions and imaged. Radiographs were acquired with standard intraoperative x-ray equipment and techniques employed at our hospital. Radiographs were acquired in AP and lateral pairs: 8 pairs for the ACF, 4 pairs for the PCF, and 3 pairs for the spine.A staff radiologist reviewed all radiographs for implanted neuropatties.

RESULTS: Sixty-two neuropatties in four sizes were imaged across 30 radiographs. All ½″ x 3″ and 1″ x 3″ neuropatties were identified on radiographs. Some ¼″ x ¼″ and ½″ x ½″ neuropatties could not be identified on radiographs. False negatives and false positives occurred because of the degree of radio-opacity of the neuropatty and overlying surgical and anatomical artifacts.

CONCLUSIONS: The orientation of a neuropatty and the regional anatomy greatly affect its visualization in the clinical setting. In regions of complex bony anatomy, ½″ x ½″ and smaller neuropatties are not identified with complete accuracy.

6. A COMPARISON OF COSTS ASSOCIATED WITH ENDOSCOPE-ASSISTED CRANIECTOMY VS. OPEN CRANIAL VAULT REPAIR FOR INFANTS WITH SAGITTAL SYNOSTOSIS

Timothy W. Vogel, MD; Albert Woo, MD; Alex Kane, MD; Kamlesh Patel, MD; Sybill Naidoo, NP; Matthew Smyth, MD (St. Louis, MO)

INTRODUCTION: Surgical management of infants with sagittal synostosis has traditionally relied on open cranial vault remodeling-(CVR) techniques; however, minimally invasive technologies including endoscope-assisted craniectomy-(EAC) repair followed by helmet therapy-(HT, EAC+HT) is increasingly used to treat various forms of craniosynostosis during the first year of life. In this study we determined the costs associated with EAC+HT in comparison to CVR.

METHODS: We performed a retrospective case-control analysis of 21 children undergoing CVR and 21 patients undergoing EAC+HT. Inclusion criteria included patients less than one year of age and one year of clinical follow-up data. The financial and clinical records were reviewed for data related to costs associated with physician, hospital, and outpatient clinic visits.

RESULTS: The average age of patients undergoing CVR was 6.8 months of age compared to 3.1 months of age for EAC+HT. Patients undergoing EAC+HT required the use of 2 helmets-(76.5%) and infrequently required a third helmet-(13.3%). EAC+HT was associated with shorter length of stays-(mean =1.10 days versus 4.67 days for CVR, $p<0.0001$), decreased rate of transfusions (9.5% versus 100% for CVR, $p<0.0001$), and decreased operative time-(81.1 minutes versus 165.8 minutes for CVR, $p<0.0001$). The overall cost of EAC+HT, accounting for hospital charges, professional and helmet charges, and clinic visits was also lower than CVR-($37,255.99 for EAC+HT versus $56,990.46, $p<0.0001$).

CONCLUSIONS: EAC+HT is a less costly surgical option for patients when compared to CVR. In addition, EAC+HT was associated with lower utilization of perioperative resources. These findings suggest that EAC+HT for infants with sagittal synostosis may be a cost-effective first-line surgical option.

7. CREATING EVIDENCE-BASED RECOMMENDATIONS FOR THE TREATMENT OF CHILDREN WITH HYDROCEPHALUS

Ann Marie Flannery, MD, FAANS, FACS; Catherine Mazzola, MD; Paul Klimo, MD; Benjamin Warf, MD; Mandeep Tamber, MD; Jay Rivas-Cambrin, MD; David Limbrick; Joanna Kemp, MD; Asim Choudhri, MD; Tina Duhaime, MD; Lissa Baird, MD; Dimitios Nikas, MD; Kurt Auguste; Mark Van Poppel, MD; Laura Raymond (St. Louis, MO)

INTRODUCTION: Evidence-based management has become important in Neurosurgery. Guidelines exist in Pediatric Neurosurgery, but not for management of hydrocephalus.

METHODS: Members of the Pediatric section and other selected experts discussed and selected topics and questions relevant to the management of Pediatric hydrocephalus. After extensive systematic review and vetting, nine review topics were determined to be of significance and likely to have some relevant and reviewable literature to support the topics. MeSH terms were generated and a research librarian conducted the searches over databases that included PubMed, and The Cochrane Central Register of Controlled Trials. The abstracts were reviewed by topic subcommittees, and relevant papers were selected for full-text review and if appropriate, analysis. Those papers found to have relevance were analyzed and evidence tables were created, using evidence-based methods approved by the Joint Guidelines Committee of the American Association of Neurological Surgeons (AANS) and the Congress of Neurological Surgeons (CNS).

RESULTS: Reviews were conducted for: timing of shunts in premature infants, effect of shunt entry point, usefulness of technical adjuvants for positioning catheters , effectiveness of endoscopic third ventriculostomy, effect of shunt design on outcome, effectiveness of pre/perioperative antibiotics, effectiveness of other shunt infection preventions, treatment of shunt infections, and the effect of ventricular size on outcome.

CONCLUSIONS: The goal was to determine if the literature had statistically significant results to support recommendations in each of these areas. The evidence to support recommendations demonstrates the limitations of the current literature.

8. PEDSNEUROSURGERY.ORG: A NEW BEGINNING

Richard C. E. Anderson, MD, FAANS; Jeffrey Leonard, MD; Ann Ritter, MD (New York, NY)

INTRODUCTION: Since 2006, the website for the AANS/CNS Joint Section on Pediatric Neurological Surgery (pedsneurosurgery.org) has been hosted by a private company Websolutions, Inc. Its platform uses proprietary software that has an outdated user interface with very limited ability to make changes. Moreover, hosting and work fees are high.

METHODS: In 2010, the website committee solicited proposals for new website designs. The AANS and four independent, private companies submitted proposals for consideration. Simultaneously, the website committee conducted a survey and collected data from Pediatric Section members regarding opinions and use of the website.

RESULTS: In 2011, the executive committee approved funding for a new website with MokaMedia, Inc. as the new host. The new website is based on open access software (Google based platform) that incorporates a content management system (WordPress) to allow flexibility of content and continual upgrades in software and design. It also substantially reduces hosting and work fees.

CONCLUSIONS: pedsneurosurgery.org has recently undergone a major transition. The new website incorporates a more contemporary user interface and has new features that benefit section members. A live demonstration of the new website will be presented.

9. OCCIPITAL NERVE DECOMPRESSION IMPROVES PEDS QOL SCORES IN CHRONIC DAILY HEADACHE**

Sohum K. Desai, MD; Sudhakar Vadivelu, DO; Gabriel Brooks, PhD; Deanna Duggan; Robert Dauser, MD; Andrew Jea, MD; William Whitehead, MD; Thomas Luerssen, MD; Robert Bollo, MD; Diana Lebron, MD; Daniel Curry, MD (Galveston, TX)

INTRODUCTION: Approximately 1% of the pediatric population suffers with Chronic Daily Headache (CDH). CDH can be a debilitating condition that affects both the child and family's quality of life. In addition to pain, this condition impacts the child's academic performance and psychosocial function at a critical time of development. We have presented the impact of Occipital Nerve Decompression on the visual analog Pain scales of a smaller series of patients. We present the impact of OND on the peds QOL scores.

METHODS: The medical records of 21 patients who had undergone occipital nerve decompression at Texas Children's Hospital were retrospectively reviewed. Pertinent patient demographics, clinical presentation, and prior treatment modalities, including pharmacotherapy, anesthetic and steroid injection was recorded. Pre- and postoperative physical and psychosocial health was assessed using the PedsQL Measurement Model, a validated scale based on 23 question survey given to parent and child.

RESULTS: There were 7 males and 14 females in our series. The average age in our series was 18 years (range, 13 – 27 years). All patients attempted other treatment modalities, including pharmacotherapy, anesthetic and steroid injection. Of the 21 patients in our series, 10 had completed the PedsQL questionnaire pre- and post-operatively. Parents reported a 15.1% and children a 13.4% improvement in physical health summary score. Furthermore parents reported a 4.4% improvement and children a 5.1% improvement in psychosocial health summary score.

CONCLUSIONS: Neurolysis of the occipital nerve appears to improve quality of life measures in patients and families with pediatric chronic daily headaches.

10. THE IMPACT OF A NOVEL ANALGESIA PROTOCOL ON CHILDREN UNDERGOING SELECTIVE DORSAL RHIZOTOMY

Robert Moore, MD; Charles Schrock, MD; Rani Sunder, MD; Tracy Wester, MD; Katherine Keech, MD; James Serot, MD; Sonia Shahrawat, MD; Sydney Nykiel, DO; T. Park, MD (St. Louis, MO)

INTRODUCTION: Selective Dorsal Rhizotomy (SDR) is the only surgical intervention with evidence supporting permanent reduction in spasticity. The post-operative course can be characterized by significant discomfort. This study evaluates a novel analgesia regimen utilizing epidurally infused ropivacaine – hydromorphone combined with scheduled intravenous ketorolac.

METHODS: Following IRB approval, the initial 31 patients receiving epidural analgesia were compared with the prior 41 patients who received systemic analgesia with a fentanyl infusion and scheduled diazepam. All surgeries were performed over an approximate six-month period by a single surgeon with relatively standardized anesthetic and nursing care. Studied outcomes included: pain scores; episodes of severe pain; nausea, itching; oxygen desaturation; and ICU admission. Data were analyzed using t-test and Fisher exact test where indicated with $p<0.05$ deemed significant.

RESULTS: Studied groups had similar demographics, biometrics and disease burdens. Patients in the epidural group had statistically and clinically significant reductions in peak recorded pain scores for each 4-hour period in the first 28 post-operative hours. Severe pain was markedly reduced in the epidural group: 9% of epidural patients had a pain score <5, compared with 68% of patients receiving systemic analgesia. Fewer epidural patients experienced oxygen desaturation during the first two post-operative days (6.5% vs. 41%, 6.5% vs. 39%). No epidural patients required ICU care.

CONCLUSIONS: Following SDR, epidural analgesia resulted in substantial improvements in pain control and safety. A similar protocol might be employed for other surgeries involving a laminectomy.

11. RISK FACTORS FOR BACLOFEN PUMP INFECTIONS: A MULTIVARIATE ANALYSIS**

Heather Stevens Spader, MD; Robert Bollo, MD; Judy Gooch, MD; Marion Walker, MD; Jay Riva-Cambrin, MD (Providence, RI)

INTRODUCTION: Intrathecal baclofen pumps have an infection rate ranging from 4% to 50%. The literature indicates that comorbidities unique to this population contribute to this high infection rate. To date, however, there has been no multivariate analysis of the risk factors leading to baclofen pump infections in children.

METHODS: We conducted a retrospective cohort univariate and multivariate analysis of patients with baclofen pumps placed between 2000 and 2012. Medical records were reviewed for infection, age, gender, race, BMI, diagnosis, Ashworth grade, PEG, ventriculo-peritoneal shunt, tracheostomy, intraoperative antibiotics, surgeon, number of people scrubbed, pump size and location, discharge disposition, CSF leak, wound dehiscence, and spinal fusion.

RESULTS: We reviewed 261 charts and found an infection rate of 9.8%. In the first five years, there was a 12% infection rate, which dropped to 7% in the last five years. This decreased infection rate correlates with the implementation in 2008 of a standardized protocol to decrease shunt infections. Age, wound dehiscence, and number of revisions were all independent risk factors for infection. Of particular interest, BMI, placement location (subcutaneous vs. subfascial), and PEG/tracheostomy were not statistically significant.

CONCLUSIONS: In our patient population, baclofen pump infection rates have been decreasing; perhaps as a by-product of an institutional culture change with implementation of a standardized protocol for shunts. We found that location, functional, and nutritional status did not play significant roles in these infections. Patients who have heretofore been deemed high risk for baclofen pumps may actually be good operative candidates.

12. DEEP BRAIN STIMULATION TO TREAT DYSTONIA IN A TRANSGENIC MOUSE MODEL OF RETT SYNDROME: TECHNICAL DESCRIPTION

Daniel J. Curry, MD; Akash Patel, MD; Jianrong Tang, MD; Zhengyu Wu; Javier Mata, MD; Huda Zoghbi, MD; Kirsten Ure, PhD (Houston, TX)

INTRODUCTION: Rett Syndrome is a genetic syndrome that features intellectual disability, and dystonia resulting from the mutation of the DNA binding protein MeCP-2. A mouse model possessing the same genetic defect recapitulates the movement disabilities at 8 months of age. Deep brain stimulation (DBS) has been used to treat primary dystonia in children, therefore its application in mouse models of genetic disease can be a tool in the investigation of interventions of childhood genetic syndromes. We report the application of DBS in the mouse model of Rett Syndrome.

METHODS: Sixteen female transgenic mice heterozygous for MeCP-2 mutation, along with sixteen FVB.129 wild type mice were implanted with electrodes into the entopeduncular nucleus bilaterally under anesthesia ofisoflurane at 2 mg/L. Electrodes were constructed from a anode, 50 mm tungsten wire passed through a cathode 130 mm cannula, 400 mm apart. The entopeduncular nucleus was targeted by using mouse atlas stereotactic coordinates AP -1.3, Lateral 1.75, and Vertical -4.4 from the bregma. Stimulation parameters were biphasic current of 100 mA , 130 Hz , and 100 ms duration. Behavioral analysis was performed by assessing open field activity, hindlimb clasping, nesting scores, and foot slip analysis.

RESULTS: All 32 mice survived the electrode implant surgery, using rigorous control of inhalational anesthetic. Both transgenic MeCP-2 mice and the wild type mice were able to tolerate daily stimulation without obvious complication, performing behavior assays while stimulating.

CONCLUSIONS: Deep brain stimulation in the mouse model of Rett Syndrome is feasible through meticulous stereotactic surgical technique and careful control of anesthesia.

13. EFFECT OF DEEP BRAIN STIMULATION ON DYSTONIC CEREBRAL PALSY IN CHILDREN

Joseph Ryan Keen, DO; Allison Przekop, DO; Joffre Olaya, MD; Frank Hsu, MD, PhD; Alexander Zouros, MD (Loma Linda, CA)

INTRODUCTION: Cerebral palsy (CP) is the most common cause of secondary dystonia in children and responds poorly to medical therapies, especially the choreoathetotic subtype. Although deep brain stimulation (DBS) is not well established for secondary dystonia, a few studies advocate using bilateral pallidal stimulation for dystonic CP. We present a small series of children with dystonic CP, who underwent bilateral pallidal DBS.

METHODS: Retrospective review of 5 consecutive children (under age 18) with dystonia-choreoathetosis CP, who underwent DBS of bilateral globus pallidus interni (GPi) between 2010 and 2012. Outcomes were assessed independently by two authors using the Barry-Albright Dystonia Scale (BADS).

RESULTS: 5 children were diagnosed with dystonia-choreoathetosis CP secondary to insults occurring before age 1. Mean age at surgery was 11 with mean follow-up of 11.4 months. Mean electrode position was 20.5 mm lateral to the AC-PC line midpoint. Mean preoperative and postoperative BADS score was 24.0 and 21.5, respectively, with mean overall percent improvement of 10.63%. Patients with at least 9 months follow-up improved 14.48% with most significant improvements occurring in those stimulated the longest. Two patients required removal of hardware within 4 months of implantation secondary to infections (1 cerebritis, 1 wound) that resolved with antibiotics.

CONCLUSIONS: Mean overall percent improvement in BADS score of 10.63%, and 14.48% for those stimulated at least 9 months, is commensurate with other published outcomes of 11.73% and 15.98% in similar populations. This reinforces DBS as a viable treatment option for childhood dystonic CP; however, there may be an increased risk of infection.

14. IMPACT OF HYDROCEPHALUS, BIRTH WEIGHT, AND EPILEPSY ON INTELLECTUAL ABILITY IN CEREBRAL PALSY**

Meysam Ali Kebriaei, MD; Ana Arenivas, PhD; Matthew Gary, MD; Kentrell Burks, MD; Donald Bearden, MS; Thomas Burns, PhD; Joshua Chern, MD, PhD (Atlanta, GA)

INTRODUCTION: Cerebral palsy (CP) is the most common motor disability of childhood and often occurs with other medical disorders including seizures, hydrocephalus, and neurocognitive impairments.

METHODS: We evaluated neuropsychological performance stratified on birth weight, presence of shunted hydrocephalus, use of antiepileptic drugs, presence of periventricular leukomalacia, history of intraventricular hemorrhage and neonatal jaundice. 131 consecutive patients with CP referred for outpatient neuropsychological evaluation were included in our study. Mean age was 10 years (range 5-20). 36% were taking antiepileptic medication at time of study. 19% had shunted hydrocephalus. Birth weight was classified to be extremely low birth weight (<1,000g) or very low birth weight (<1,500g) in 24% and 20% of study population, respectively. General linear models were used to analyze differences across categories.

RESULTS: Full scale intelligence quotient(FSIQ) was lower when shunted hydrocephalus was present [$F(1,108)=9.55, p<.01$] and when antiepileptic drugs use was present [$F(1,108)=11.6, p<.01$]. Visual motor integration performance was lower when antiepileptic use was present [$F(3,48)=10.2, p<.01$. No significant FSIQ differences were found based on birth weight distribution. Numbers of previous shunt revision also failed to correlate with IQ differences.

CONCLUSIONS: The results of this study suggest shunted hydrocephalus (but not the number of revisions) and antiepileptic drug use in patients with CP result in lower full scale intelligence quotient and visual motor integration performance. Understanding factors contributing to specific neuropsychological deficits associated with CP is important as it is the most common motor disability of childhood.

15. ATTEMPTED BLADDER REINNERVATION IN SPINAL CORD INJURY: CLINICAL, ELECTROPHYSIOLOGIC AND HISTOLOGIC OUTCOME AFTER THE XIAO PROCEDURE

Gerald F. Tuite Jr., MD, FAANS; Bruce Storrs, MD; Yves Homsy, MD; Sarah Gaskill, MD; Ethan Polsky, MD; Margaret Reilly, BS; Steven Winesett, MD; Luis Rodriguez, MD; Carolyn Carey, MD; Sharon Perlman, MD; Lisa Tetreault, RN (St. Petersburg, FL)

INTRODUCTION: An intradural somatic to autonomic anastomosis (the "Xiao procedure") has been previously described to create a "skin-CNS-bladder" reflex that has been reported to improve bladder and bowel function in patients with neurogenic bladder and bowel dysfunction.

METHODS: We present our experience with one 10-year-old boy with chronic neurogenic bladder and bowel dysfunction related to spinal cord injury, who underwent the Xiao procedure under Dr. Xiao's supervision as part of an IRB-approved multidisciplinary study.

RESULTS: After undergoing a left L5 ventral root to left S2/S3 intradural anastomosis, the patient reported that his bladder and bowel dysfunction improved between six and twelve months. However, two years after the procedure, he reported that there was no change in his bladder or bowel dysfunction compared to his condition prior to the procedure. Electrophysiological and histological evaluation of the previously performed anastomosis during surgical re-exploration three years after the Xiao procedure showed that the anastomosis was in anatomic continuity but that neuroma formation had prevented reinnervation. Nerve action potentials were not demonstrable across the anastomosis and stimulation of the nerve above and below the anastomosis created no bladder or perineal contractions.

CONCLUSIONS: This is the first clinical report of the outcome of the Xiao procedure in a child with spinal cord injury performed outside China. Our findings suggest that some previously observed changes could be related to factors other than the establishment of a skin-CNS-bladder reflex as a result of a somatic to autonomic anastomosis.

16. DISRUPTION OF ROLANDIC GAMMA-BAND FUNCTIONAL CONNECTIVITY BY SEIZURES IS ASSOCIATED WITH MOTOR IMPAIRMENTS IN CHILDREN

With Epilepsy**

George M. Ibrahim, MD; Tomoyuki Akiyama, MD, PhD; Ayako Ochi, MD, PhD; Hiroshi Otsubo, MD; Mary Lou Smith, PhD; Margot Taylor, PhD; Elizabeth Donner, MD; James Rutka, MD, PhD; O. Carter Snead, MD; Sam Doesburg, PhD (Toronto, Canada)

INTRODUCTION: Although children with epilepsy exhibit numerous neurological and cognitive deficits, the mechanisms underlying these impairments remain unclear. Synchronization of oscillatory neural activity in the gamma frequency range (<30 Hz) is purported to be a mechanism mediating functional integration within neuronal networks supporting cognition, perception and action. Here, we tested the hypothesis that seizure-induced alterations in gamma synchronization are associated with functional deficits.

METHODS: By calculating synchrony among electrodes and performing graph theoretical analysis, we assessed functional connectivity and local network structure of the hand motor area of fifteen children with focal epilepsy from intracranial electroencephalographic recordings. Functional connectivity metrics were compared to neuropsychological outcomes of motor dexterity and the presence of motor weakness on neurological examination.

RESULTS: A local decrease in inter-electrode phase synchrony in the gamma bands during ictal periods, relative to interictal periods, within the motor cortex was strongly associated with clinical motor weakness. Gamma-band ictal desychronization was a stronger predictor of deficits than the presence of the seizure-onset zone or lesion within the motor cortex. There was a positive correlation between the magnitude of ictal desychronization and impairment of motor dexterity in the contralateral, but not ipsilateral hand. There was no association between ictal desynchronization within the hand motor area and non-motor deficits.

CONCLUSIONS: This study uniquely demonstrates that seizure-induced disturbances in neuronal oscillatory dynamics and functional connectivity are associated with network-specific neurological deficits.

17. VOLUMETRIC CT ANALYSIS AS A PREDICTOR OF SEIZURE OUTCOME FOLLOWING TEMPORAL LOBECTOMY

Steven J. Schiff, MD, PhD, FAANS; Jason Mandell, MS; Kenneth Hill, MD; Dan Nguyen, MD; Kevin Moser, MD; Robert Harbaugh, MD; James McInerney, MD; Bryan Kaaya; Derek Johnson, BS; Warren Boling, MD; Benjamin Warf, MD; Andrew Webb, PhD (University Park, PA)

INTRODUCTION: The incidence of temporal lobe epilepsy (TLE) due to mesial temporal sclerosis (MTS) can be high in developing countries.Current diagnosis of MTS relies on structural MRI, which is generally unavailable in developing world settings. Given widespread effects on brain structure beyond hippocampal atrophy in TLE, we proposed that CT volumetric analysis can help predict outcomes following resection.

METHODS: Ten pediatric patients received preoperative CT scans and temporal resections at the CURE Children's Hospital of Uganda. Engel's classification of seizure control was determined 12 months postoperatively. Temporal lobe volumes were measured from CT and from normative MRIs using the Cavalieri method. Whole brain and fluid volumes were measured using particle filter segmentation. Linear discrimination analysis (LDA) was used to classify seizure outcome by these brain volumes.

RESULTS: Epilepsy patients showed normal to small brain volumes and small temporal lobes bilaterally. A multivariate measure of the volume of each temporal lobe separated patients that were seizure-free (Engel IA) from those with incomplete seizure control (Engel IB/IIB) with LDA ($p < 0.01$). Temporal lobe volumes also separate normal subjects, IA, and IB/IIB outcomes ($p < 0.01$). Additionally, we demonstrated that age-normalized whole brain volume, in combination with temporal lobe volumes, may further improve outcome prediction ($p < 0.01$).

CONCLUSIONS: This study shows strong evidence that temporal lobe and brain volume can be predictive of seizure outcome following temporal lobe resection, and that volumetric CT analysis of the temporal lobe may be feasible in lieu of structural MRI when the latter is unavailable.

18. SEIZURE OUTCOMES FOLLOWING STEREOELECTROENCEPHALOGRAPHY-GUIDED RESECTIVE EPILEPSY SURGERY IN CHILDREN: A LONGITUDINAL ANALYSIS

Aria Fallah, MD; George Ibrahim, MD; Sumeet Vadera, MD; Jeffrey Mullin, MD; Jorge Gonzalez-Martinez, MD, PhD (Toronto, Canada)

INTRODUCTION: Stereoelectroencephaloraphy (SEEG) is a valuable and underutilized tool in the evaluation of medically-intractable focal epilepsy. Here, we report seizure outcomes following stereoelectroencephalography (SEEG)-guided resective epilepsy surgery in a consecutive series of children with difficult to localize epilepsy.

METHODS: A retrospective, independent chart review was performed to determine the seizure outcomes of eligible patients identified through a prospective database maintained by the senior author. Time-to-event (TTE) analysis was performed. The 'event' was defined as any seizure following post SEEG-guided resection (not including seizures in the first postoperative week and auras).

RESULTS: Nine patients (7 males) underwent resective epilepsy surgery at the Cleveland Clinic, Cleveland USA from July 2009 to October 2010 following SEEG evaluation. The mean age of patients at the time of SEEG-guided resection was 13.7±4.4 years (range: 5-18 years. Only 3 children had an identifiable lesion on MRI. Pathology was consistent with malformation of cortical development in 6 children and was normal in 3 children. The mean time-to-seizure recurrence was 9.0 months (95% CI: 4.1-15.0 months). Engel Class I outcome was achieved in 3 (33%) patients. SEEG placement and removal was not associated with any complications.

CONCLUSIONS: In this consecutive cohort of children with highly complex medically refractory epilepsy with no further treatment option for seizure control, the SEEG method provided an additional opportunity for seizure freedom in 33% of patients. Larger series and longer follow-up are needed to validate our results.

19. SURGICAL OUTCOME AND PROGNOSTIC FACTORS IN CHILDREN WITH MEDICALLY INTRACTABLE EPILEPSY CAUSED BY FOCAL CORTICAL DYSPLASIA

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INTRODUCTION: Focal cortical dysplasia (FCD) is a common cause of medically intractable epilepsy (MIE) and a common pathologic finding in pediatric epilepsy surgery cases. Prognostic factors in patients with FCD are sought.

METHODS: All epilepsy surgery patients with FCD operated at Childrens Hospital Colorado between 2001 and 2008 were retrospectively analyzed. Data collection include age at seizure onset, duration of seizures, development, imaging findings, FCD type, FCD location, surgery type, completeness of epileptogenic zone (EZ) resection, and Engel outcome. Outcome predictors were sought using ordinal logistic regression.

RESULTS: Eighty-two patients were studied. Median duration of epilepsy prior to surgery was 67 months. Median follow-up was 64 months. Developmental delay was present in 44 patients. Twenty-five patients had a temporal lobe focus. Twelve had a non-lesional MRI. Nineteen patients had mild malformation of cortical development (mMCD), 14 had FCD type 1, 23 had FCD type 2 and 26 had FCD type 3. Complete resection of the EZ was accomplished in 63 patients. Overall, 56 patients (68.3%) are seizure free, 17 (20.7%) have Engle class 2 outcome, 9 (11%) Engle class 3, and zero Engle class 4. Complete resection of the EZ strongly correlated with favorable outcome (p=0.0001). Normal development trended toward favorable outcome but did not reach significance (p=0.09). FCD type and location of epileptogenic zone showed no correlation with outcome.

CONCLUSIONS: These findings confirm the benefit of epilepsy surgery in patients with FCD. Complete resection of the EZ is the most important determinate of seizure outcome.

20. NAVIGATING ELOQUENT CORTEX: COMBINED UTILITY OF NEUROIMAGING, NEUROMONITORING AND CORTICAL MAPPING IN ROLANDIC EPILEPSY SURGERY

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INTRODUCTION: Peri-Rolandic cortical resections for the treatment of medically-intractable epilepsy may be associated with considerable post-operative neurological deficits. More accurate mapping of the Rolandic cortex may mitigate the risk to patients. Here, we evaluate the combined utility of magnetic resonance imaging (MRI), magnetoencephalography (MEG), neuromonitoring and cortical mapping in guiding Rolandic resections.

METHODS: A retrospective chart review was performed of patients who underwent resective epilepsy surgery involving Rolandic cortex at the Hospital for Sick Children. The primary outcomes of interest were the concordance of pre-operative and intra-operative modalities in localizing the precentral sulcus, as well as seizure and neurological outcomes following Rolandic resection.

RESULTS: Eight children (4 males) with a mean age of 13.6 years and mean epilepsy duration of 9.0 years were included in the study. Structural MRI was normal in 3 patients (37.5%), whereas the remaining demonstrated a peri-Rolandic cortical abnormality. MEG evoked-potentials, intraoperative neuromonitoring (phase reversal) and cortical mapping using a trains-of-five paradigm identified the Rolandic cortex in all patients. The Penfield cortical mapping paradigm was unsuccessful in 2 patients (33%). Seven patients underwent extraoperative mapping by consecutively stimulating implanted electrodes, which successfully identified the motor strip in all subjects. Seven patients experienced expected hemiparesis immediately post-operatively, all of whom were ambulatory within 6 months. All patients achieved a satisfactory seizure outcome (Engel class I or II).

CONCLUSIONS: Combining non-invasive neuroimaging with intra- and extra-operative cortical mapping provides robust localization of Rolandic cortex, which may mitigate iatrogenic neurological deficit and guide more informed pre-surgical discussions.

21. SURGERY FOR INTRACTABLE EPILEPSY DUE TO UNILATERAL BRAIN DISEASE: A RETROSPECTIVE STUDY COMPARING HEMISPHERECTOMY TECHNIQUES

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INTRODUCTION: The major surgical approaches for hemispherectomy are: anatomic hemispherectomy (AH), traditional functional hemispherectomy (FH), and peri-insular hemispherotomy (PIH). We describe the outcome after hemispherectomy in children with severe unilateral cortical disease secondary to acquired brain lesions vs. developmental lesions.

METHODS: We conducted a retrospective chart review of patients who underwent hemispherectomy at Boston Children's Hospital between 1997–2011. Outcome after surgery was measured with the Engel score at 12 months. Secondary outcome was measured in terms of reoperation and need for VP shunt.

RESULTS: Among 36 consecutive patients, group 1 (n=14) had static acquired lesions, and Group 2 (n= 22) had developmental lesions. Outcome related to seizure control was good in both groups (Engel score I for 25). In Group 1, five patients underwent AH, six underwent FH, and three underwent PIH; none required a second procedure. In Group 2, 14 had AH, six had FH, and two had PIH. In Group 2, among two patients who had FH, one required reoperation to complete the disconnection by AH, and one subsequently underwent completion PIH due to persistent seizures. Two more patients required repeat PIH. Among four patient needing reoperation, two had malformations of cortical development (MCD) and two had hemimegalencepahly. 13 patients needed VP shunt placement, all of which underwent AH but one.

CONCLUSIONS: Our data suggests good seizure outcome following hemispherectomy in either groups with either approaches. We observed a higher complication rate with AH. Patients with developmental lesions are at small risk of need for reoperation.

22. MRI GUIDED STEREOTACTIC LASER THERMAL ABLATION TECHNIQUE IN EPILEPSY SURGERY – OUR INITIAL EXPERIENCE

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INTRODUCTION: Cortical resection with intraoperative ECOG is the standard treatment for patients with refractory lesional epilepsy. We present four patients with cortical abnormalities treated with stereotactic placement of laser probe and thermal ablation under MRI guidance.

METHODS: We retrospectively reviewed the medical records of four epilepsy patients treated with MRI guided stereotactic laser thermal ablation for cortical abnormality. One patient was treated primarily with this technique, and in other three patients, this was used to treat margins of prior open surgical resection. Frame based stereotaxy was used for placement of fibre optic probe in the lesion and with MRI guidance laser thermal coagulation was performed. Real time MR images allowed live evaluation of target temperature and protection of surrounding tissues.

RESULTS: The procedure was well tolerated by all patients with no perioperative complications. Following ablation, the lesion showed low T2 weighted signal consistent with protein denaturalisation and a halo of surrounding restriction in diffusion suggestive of ischemia or infarction. Post procedural followup shows two patients at Engel class I (seizure free), one of whom required second ablation. In patients who were not cured, one was Engel class III and the other at Engel class IV. Mean length of hsopital stay was 1.6 days.

CONCLUSIONS: This preliminary experience with Stereotactic laser thermal ablation under MRI guidance in children with medically refractory lesional epilepsy demonstrates that this approach can be used safely. This technique may be a suitable alternative to open resection and long term follow up is required for better understanding of seizure control.

23. PREDICTORS OF SEIZURE OUTCOMES IN CHILDREN WITH TUBEROUS SCLEROSIS COMPLEX AND INTRACTABLE EPILEPSY UNDERGOING RESECTIVE EPILEPSY SURGERY: AN INDIVIDUAL PARTICIPANT DATA META-ANALYSIS**

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INTRODUCTION: We performed a systematic review and individual participant data meta-analysis to identify preoperative factors associated with a good seizure outcome in children with Tuberous Sclerosis Complex undergoing resective epilepsy surgery.

METHODS: We searched electronic databases (MEDLINE, EMBASE, CINAHL and Web of Science), archives of major epilepsy and neurosurgery meetings, and bibliographies of relevant articles, with no language or date restrictions. We included case-control or cohort studies of consecutive participants undergoing resective epilepsy surgery that reported seizure outcomes. To identify predictors of a good seizure outcome (i.e. Engel Class I or II) we used logistic regression adjusting for length of follow-up for each preoperative variable.

RESULTS: Of 9863 citations, 20 articles reporting on 181 participants were eligible. Good seizure outcomes were observed in 126 (69%) participants (Engel Class I: 102(56%); Engel class II: 24(13%)). In univariable analyses, absence of generalized seizure semiology (OR=3.1, 95%CI=1.2-8.2, p=0.022), no or mild developmental delay (OR=7.3, 95%CI=2.1-24.7, p=0.001), unifocal ictal scalp electroencephalographic (EEG) abnormality (OR=3.2, 95%CI=1.4-7.6, p=0.008) and EEG/Magnetic resonance imaging concordance (OR=4.9, 95%CI=1.8-13.5, p=0.002) were associated with a good postoperative seizure outcome.

CONCLUSIONS: Small retrospective cohort studies are inherently prone to bias, some of which are overcome using individual participant data. The best available evidence suggests four preoperative factors predictive of good seizure outcomes following resective epilepsy surgery. Given the low incidence of children with Tuberous Sclerosis Complex undergoing epilepsy surgery, large long-term prospective multicenter observational studies are required to further evaluate the risk factors identified in this review.

24. FROM TWO SURGERIES TO ONE: ADVANCED NEUROIMAGING REDUCES INVASIVE MONITORING IN PEDIATRIC EPILEPSY SURGERY

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INTRODUCTION: Surgical management of epilepsy in children traditionally requires implantation of intracranial electrodes to localize epileptogenic cortex and map function, and a second therapeutic surgery for resection. Intraoperative image guidance merging structural and tractography data with magnetoencephalogram (MEG), PET, and fMRI, along with intraoperative corticography and functional mapping, can provide requisite information on both efficacy and safety of resection in one surgical procedure for selected patients. We noticed a decrease in use of invasive monitoring during the past several years as our confidence in noninvasive methods has increased. We report our recent experience for children with non-neoplasm-related intractable epilepsy in whom invasive monitoring was considered, but who instead underwent single stage surgeries relying on these techniques.

METHODS: Patients ranged from 3 to 11 years old (median = 4 years). Diagnoses include tuberous sclerosis, cortical dysplasia, neonatal hemorrhage, and encephalitis. Coregistration of high-resolution structural imaging, tractography, MEG, and PET defined initial target for, and limits of, resection. Intraoperative corticography before and after resection also helped define completion of resection, and functional mapping of motor and tract data was used to preserve function.

RESULTS: Post-operatively, all patients have remained seizure free (Engel I - range of follow-up 1 to 6 months) with no new focal neurological deficit.

CONCLUSIONS: Multi-modality non-invasive preoperative evaluation merged with intraoperative image guidance and functional mapping may help reduce the need for chronic subdural and depth electrode monitoring in children with intractable epilepsy. Further followup and larger series will better define the utility and limits of this approach.

25. FUNCTIONAL LESIONECTOMY: A MINIMALLY RESECTIVE STRATEGY EFFECTIVE IN CHILDREN WITH MRI-NEGATIVE, INTRACTABLE EPILEPSY

John Ragheb, MD; Sanjiv Bhatia, MD, FAANS, FACS; Ann Hyslop, MD; Ian Miller, MD; Prasanna Jayakar, MD (Miami, FL)

INTRODUCTION: Excisional surgery achieves seizure-freedom in a large proportion of children with MRI negative epilepsy, but the resections based on functional data are often extensive. We explored the possibility that more restricted resections within a carefully selected MRI negative cohort could achieve comparable success. .

METHODS: We report a subset of 25 children with MRI-negative, intractable partial epilepsy who underwent focal corticectomy at our institution between the years of 2005-2011. The epileptogenic region was identified by integrating multimodal functional data. Corticectomies were minimized by resecting regions that showed convergence of multimodal abnormalities including 3-D EEG source localization, SPECT, PET and invasive EEG data.

RESULTS: Resections were convergent with scalp EEG in all cases, 3-D EEG source localization of scalp interictal data in 9, focal ictal SPECT hyperperfusion in 10, highly localized PET hypometabolism in 8 and hypermetabolism in 2, focal interictal and/or ictal discharges on intraoperative ECoG in 23, and focal ictal onset during extraoperative subdural monitoring in 13 patients. Resections were considered complete in 7 and incomplete in 18. At 1 year follow-up, 13/25 (52%) were seizure-free, 5 (20%) experienced persistent seizures with <90% reduction in frequency, and the remaining 7 (28%) had no change in seizure burden. Outcomes were unrelated to completeness of resection or type of cortical dysplasia.

CONCLUSIONS: Our findings demonstrate that functional lesionectomy is successful in a selected subset of MRI negative cohort. Minimizing resection based on convergent mulitmodal functional data helps avoid unnecessarily large resections and may have important implications for seizure control and developmental outcome.

26. CALVARIAL THICKNESS AND DIPLOIC SPACE DEVELOPMENT IN CHILDREN WITH SAGITTAL SYNOSTOSIS ASSESSED BY COMPUTED TOMOGRAPHY

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INTRODUCTION: We compare calvarial thickness (CALV) and diploic thickness (DIPL) in children with corrected sagittal synostosis to those of normal controls. We also compare these measures in children after correction by an open (OPEN) or endoscopic (ENDO) approach.

METHODS: Post-operative CT scans of children with sagittal synostosis corrected by OPEN (n = 26) or ENDO (n = 26) approach were compared to controls without craniosynostosis (n = 47). CALV and DIPL were measured using Analyze 11.0 at 40 points over 4 zones: frontal, anterior parietal, posterior parietal, and occipital. Regression analysis was used to compare CALV and DIPL controlling for gender and age.

RESULTS: Adjusted mean DIPL was less in post-operative patients with sagittal synostosis compared to normal controls (0.19 ± 0.06mm, $p = 0.002$). Adjusted mean CALV was equivalent in both groups ($p = 0.98$). However, in patients with sagittal synostosis CALV was thicker in the frontal zone ($p = 0.002$). DIPL in OPEN and ENDO subjects were equivalent ($p = 0.977$). ENDO calvaria were thinner (mean adjusted overall difference 0.65 ± 0.27mm, $p = 0.020$). Age of subjects ranged from 10 months to 14.75 years (mean = 2.47 years). Age at time of scan was a significant factor ($p < 0.001$). Gender was not a significant factor ($p < 0.20$).

CONCLUSIONS: Children with corrected sagittal synostosis have thinner DIPL and equivalent CALV when compared to normal controls. After correction, CALV is less by the ENDO approach compared to the OPEN approach; there is no difference in DIPL, however.

27. LESS-INVASIVE PEDICLED OMENTAL-CRANIAL TRANSPOSITION IN PEDIATRIC PATIENTS WITH MOYAMOYA DISEASE AND FAILED PRIOR REVASCULARIZATION

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INTRODUCTION: Patients with Moyamoya disease and progressive neurologic deterioration despite previous revascularization pose a major treatment challenge. Many have exhausted typical sources for bypass or have ischemia in areas that are difficult to reach with an indirect pedicled flap. Omental-cranial transposition is an effective but sparingly used technique because of its associated morbidity.

METHODS: We have refined a laparoscopic method of harvesting an omental flap that preserves its gastroepiploic arterial supply. The pedicled omentum can be lengthened as needed by dividing it between the vascular arcades. It is transposed to the brain via skip incisions. The flap can be trimmed or stretched to cover ischemic areas of the brain. The cranial exposure is performed in parallel.

RESULTS: We performed this technique in three pediatric patients (aged five to twelve years) with Moyamoya disease, prior STA-MCA bypasses, and progressive ischemic symptoms. In one patient, we transposed omentum to both hemispheres. Blood loss ranged from 75 to 250 ml. The patients tolerated a diet immediately post op and were discharged in three to five days. All three children's ischemic symptoms resolved within three months post-operatively. MRI at one year showed improved

perfusion and no new infarcts. Angiography showed excellent revascularization of targeted areas and patency of the gastroepiploic arterial pedicle.

CONCLUSIONS: Laparoscopic omental harvest for cranial-omental transposition can be done efficiently and safely. Patients appear to tolerate this technique much better than laparotomy. We can achieve excellent angiographic revascularization and resolution of ischemic symptoms.

28. INTRA- AND INTER-RATER RELIABILITY OF THE PEDIATRIC AVM COMPACTNESS SCORE

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INTRODUCTION: Cerebral arteriovenous malformations (AVM) have a higher post-resection recurrence rate in children than in adults. Our previous study demonstrated that a diffuse AVM (low compactness score) predicts post-resection recurrence. The aims of this study were to evaluate the intra- and inter-rater reliability of our AVM compactness score.

METHODS: Angiograms of 24 patients assigned a preoperative compactness score (scale of 1 to 3, 1=most diffuse, 3= most compact) in our previous study were re-rated by the same neuroradiologist 9 months later. A pediatric neurosurgeon, pediatric neuroradiology fellow, and interventional radiologist blinded to each other's ratings, the original ratings, and AVM recurrence also rated each AVM's compactness. The intra- and inter-rater reliabilities were calculated using the kappa (κ) statistic.

RESULTS: Of the 24 AVMs, scores by the original neuroradiologist were a score of 1 in 6, 2 in 16, and 3 in 2 AVMs. The intra-rater reliability was 1.0. The κ among the four raters was 0.69 [95% confidence interval (CI) 0.44-0.89], which indicates substantial reliability. The inter-rater reliability between the neuroradiologist and neuroradiology fellow was moderate (κ=0.59, 95%CI 0.20-0.89) and was substantial between the neuroradiologist and neurosurgeon (κ=0.74, 95%CI 0.41-1.0). The neuroradiologist and interventional radiologist had perfect agreement (κ=1.0).

CONCLUSIONS: Intra- and inter-rater reliability of AVM compactness scoring were excellent and substantial, respectively. These results demonstrate that the AVM compactness score is reproducible. However, since the neuroradiologist and interventional radiologist had perfect agreement, this indicates that the compactness score is most accurately applied by those with extensive angiography experience.

29. SKULL GROWTH AND CRANIAL VAULT VOLUMES IN SAGITTAL SYNOSTOSIS

Rahel Ghenbot; Gary Skolnick, BS; Kamlesh Patel, MD; Sybill Naidoo, NP; Matthew Smyth, MD; Albert Woo, MD

INTRODUCTION: There have been conflicting reports on how sagittal synostosis affects cranial vault volume (CVV) and which surgical approach best normalizes the volume. In this study, we compare the CVV and cranial index (CI) of children with sagittal synostosis (before and after surgery) to those of controls. We also compare the effect of surgery type.

METHODS: CT scans of 33 children with sagittal synostosis and 40 age and gender matched controls were evaluated using Analyze 11.0 and previously validated automated segmentation software for CVV. 16 cases underwent open surgery (open), 16 underwent endoscopic surgery (endo).

RESULTS: The adjusted mean CVV for cases before surgery was 42cc smaller than controls ($p = 0.174$). The adjusted mean CVV of postoperative children was 1.5cc larger ($p = 0.971$). There was no significant difference between open and endo cases' CVVs postoperatively ($p = 0.305$). The CI increased 12% ± 6% in both open and endo cases; there was no significant difference in mean CI ($p = 0.141$) between the two groups. There was a trend toward greater CVV growth after surgery in endo cases (as compared to open) ($p = 0.082$).

CONCLUSIONS: Young children with sagittal synostosis have no significant difference in CVV compared to controls. The type of surgery does not seem to affect CI and CVV one year postoperatively. Both procedures result in CVVs similar to that of controls. The data hint that growth post-surgery may be greater in children who undergo the endoscopic procedure, but greater power is needed to fully evaluate this hypothesis.

30. ANTERIOR FONTANELLE SIZE AND CLOSURE IN FULL TERM CHILDREN BASED ON HEAD COMPUTED TOMOGRAPHY**

Jonathan A. Pindrik, MD; Boram Ji, BS; Courtney Pendleton, MD; Edward Ahn, MD (Baltimore, MD)

INTRODUCTION: Anterior fontanelle size and time of closure vary considerably. Most studies neglect population characteristics of anterior fontanelles and implement clinical measurement techniques. This study provides computed tomography (CT) acquired ranges of anterior fontanelle closure (AFC) and surface area (SA) across monthly age groups of children.

METHODS: High resolution 3-dimensional reconstructed head CT scans of full term children without congenital or chronic structural neurologic abnormality between ages 0 and 24 months were retrospectively reviewed. Intersection of coronal and sagittal sutures indicated AFC. Measurement of fontanelle width (W) and antero-posterior (AP) diameter based on tangential outlines of patent fontanelles allowed approximation of anterior fontanelle SA (SA = W * AP * [1/2]). AFC prevalence and median SA with standard deviation were calculated for each age group.

RESULTS: Between 15 and 23 head CT scans per monthly age group (0-24 months) were reviewed, totaling 464 scans. The frequency of AFC increased steadily from 9 to 24 months (9 months: 5.3%; 24 months: 90.0%), and reached above 50% at age 16 months (52.9%). Between ages 20-24 months, AFC prevalence remained between 87.5-90.0%. Dramatic changes in median SA occurred between ages 4-5, 9-10, and 13-14 months (4 months: 954.4 mm2; 5 months: 623.2 mm2; 9 months: 444.9 mm2; 10 months: 225.3 mm2; 13 months: 176.6 mm2; 14 months: 59.9 mm2). Median anterior fontanelle SA peaked at age 2 months (1022.2 mm2).

CONCLUSIONS: Radiographic cross-sectional studies present population characteristics of AFC and SA across pediatric monthly age groups.

31. PEDIATRIC MOYA-MOYA: SURGICAL VARIATION, SEIZURE OUTCOMES, AND ANGIOGRAPHIC FOLLOW-UP**

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INTRODUCTION: Although it has become well-accepted that encephalo-duro-arterio-(myo)-synangiosis (EDAS/EDAMS) results in excellent outcomes for children with Moya-Moya, occasional treatment failures mandate further study to determine the best intervention for each patient.

METHODS: We analyzed all the EC-IC by-pass cases performed on Moya-Moya patients at Vanderbilt Children's Hospital (VCH) since 2006. For each patient, the following data was recorded: type of surgery, operative time, estimated blood loss, duration of stay, complications, seizure outcome, and status at last clinical and angiographic follow-up. The most commonly performed procedure was the EDAS or EDAMS indirect by-pass, however direct, end-to- side, STA-MCA by-pass was successfully performed in two patients and attempted in a third patient but aborted due to small vessel caliber.

RESULTS: Seventeen patients were treated with by-pass procedures performed on a total of twenty-eight hemispheres. Nine were deemed to have Moya-Moya syndrome because of associated conditions such as NF1 (2/17), Down's syndrome (3/17), or sickle cell anemia (4/17). Mean operative time, estimated blood loss, and mean hospital stay were 330 minutes, 178 mL, and 2.5 days, respectively. No patient experienced further strokes following surgery although a number of minor complications were noted.

CONCLUSIONS: EC-IC by-pass is a safe and relatively simple intervention which provides excellent protection from future ischemic events in children with Moya-Moya disease. Outcomes seem to be equivalent in patients with "Moya-Moya syndrome". The effect of surgery on seizures is variable. Interestingly, post-operative angiographic revascularization was not always evident even in some patients who enjoyed a good clinical outcome.

32. FEATURES OF CEREBRAL ARTERIOVENOUS MALFORMATIONS IN CHILDREN

Andrei B. Talanov, MD, PhD (Ivanovo, Russian Federation)

INTRODUCTION: Clinical and theoretical studies indicate a certain changeability of cerebral arteriovenous malformations (AVMs) during lifetime. This research was aimed at estimation of AVMs features in children in comparison with adults.

METHODS: The study was carried out in 273 prospectively collected patients (165 men, 108 women, mean age 23,9 years). Patients were hospitalized at surgical departments of Burdenko Neurosurgical Institute from January 1986 till September 2002. There were 85 children (age less than 15 years) and 188 adults. The following characteristics were analyzed: gender, type of presentation (hemorrhagic, non-hemorrhagic), arterial supply (cortical, non-cortical), draining system (compact, diffuse), nidus (fistula, plexiform), location (supratentorial superficial and deep, subtentorial); presence or absence of angiomatous changers, intranidal aneurisms, associated aneurisms and venous varixes. Chi-square statistics was used. Significance was accepted when p was less than 0,05.

RESULTS: There was predominance of male (p less than 0,05), fistulas (p less than 0,0005), subtentorial AVMs (p less than 0,005) and intranidal aneurisms (p less than 0,05) in children. Associated aneurisms and angiomatous changers were less common in children than in adults (p less than 0,05 and p less than 0,01 respectively). Differences in other characteristics were not significant.

CONCLUSIONS: Cerebral AVMs in children and adults are dissimilar pathology. Along with lifetime changers, probably, there are variants of AVMs the difference between which is determined congenitally. Predominance of certain AVMs in different periods of life may be explained by phase hemodynamic changers implied in biophysical principles.

33. MULTI-CONCENTRIC OSTEOTOMY FOR CORRECTION OF CRANIAL DEFORMITIES: CASE SERIES AND FOLLOW-UP

Jennifer Gentry Savage, MD; Micam Tullous, MD; Patricia Mancuso, MD (San Antonio, TX)

INTRODUCTION: The authors report a case series and in-depth description of the multi-concentric osteotomy technique, MCO, which is utilized to provide immediate correction of existing deformities, primarily scaphocephaly associated with sagittal synostosis.

METHODS: 21 patients ranging from age 7-24 months with scaphocephaly secondary to sagittal suture synostosis and 9 patients from age 1-9 years with severe plagiocephaly, underwent cranial vault remodeling and expansion utilizing the MCO technique. For patients with scaphocephaly secondary to sagittal synostosis, bilateral MCOs were performed, all hinging on the coronal suture. After achievement of appropriate contour, absorbable plates and screws were applied to the posterior aspect of the construct for stabilization. For patients with severe plagiocephaly, MCO was customized for correction of the specific deformity.

RESULTS: All patients demonstrated immediate post-operative correction of the deformity and all constructs maintained their original shape and position. Pre-operative cranial index measurements in the sagittal synostosis group ranged from 59-67 (mean of 64) and postoperative cranial indexes ranged from 68-82 (mean 75) giving an overall increase in cranial index of 9-14 with a mean increase of 11. There were no incidences of post-operative intracranial hypertension.

CONCLUSIONS: The MCO procedure allows for cranial expansion and correction of biparietal narrowing associated with sagittal synostosis in addition to other focal cranial deformities. This technique offers the ability to perform the osteotomies in-situ allowing for preservation of the sutures, when feasible, and also allows for reduced manipulation thereby decreasing operative time and subsequent complications.

34. THE SAFETY OF THE INTRAOPERATIVE SACRIFICE OF THE DEEP CEREBRAL VEINS

J. McComb, MD; Laurence Davidson, MD (National Naval Medical Ctr, MD)

INTRODUCTION: The effect of surgically ligating the deep cerebral veins is often thought to be of significant risk. That concern and the paucity of information on surgery of the deep venous system confound surgical decision making when operations involve manipulation of the deep cerebral veins.

METHODS: A retrospective review, covering the period from 1997 to 2009, was undertaken to analyze our own clinical experience with intra-operatively sacrificing deep cerebral veins.This was combined with an extensive review of the available literature on the complications of sacrificing such veins.

RESULTS: Our series consisted of 29 cases of posterior inter-hemispheric retro-callosal approach for resection of pineal region and posterior fossa lesions in children. Intra-operatively, deep cerebral veins were sacrificed in 3 patients while a single bridging vein was occluded and divided in 6 and 2 such veins in another. In no case was there sacrifice of both superficial and deep veins. No patient developed radiographic evidence of venous infarction. Our literature search yielded a paucity of venous infarcts secondary to sacrifice of deep cerebral veins.

CONCLUSIONS: Robust experimental studies and limited clinical experience indicate that occlusion of one or several deep veins is generally safe.

35. PROTEIN PROFILING OF DIFFUSE INTRINSIC PONTINE GLIOMA TUMOR TISSUE: A COMPARATIVE ANALYSIS**

Amanda Muhs Saratsis, MD; Kendall Snyder; Jordan Hall; Madhuri Kambhampati; Sridevi Yadavilli, PhD; Jennifer Perez, BA; Suresh Magge, MD; Javad Nazarian, PhD (Arlington, VA)

INTRODUCTION: Diffuse Intrinsic Pontine Glioma (DIPG) is a rare, highly morbid form of pediatric brainstem glioma for which molecular characterization is limited. Comparative proteomic analysis has emerged as a valuable tool for understanding cancer biology. We previously generated protein profiles of CSF and formalin fixed tumor specimens from DIPG patients. Here, we report the comprehensive proteome of 50 frozen tissue specimens, including DIPG tumor (n=17), normal brainstem (n=17), and other pediatric brain tumors (n=16).

WITHDRAWN

METHODS: Tissue was collected intraoperatively or post-mortem. Extracted total protein was resolved using 1D SDS-PAGE, in-gel tryptic digestion and MS/MS quantitative proteomic analysis using LTQ-Orbitrap-XL. Isolated peptides were identified using the Sequest algorithm in the Bioworks browser against the Uniprot Human database. Comparative analysis was performed with ProteoIQ and Ingenuity Pathway Analysis (IPA) software.

RESULTS: Comprehensive profiling identified 2,305 tissue proteins, 50 unique to DIPG tumor tissue, with no significant difference in the number of proteins detected in postmortem vs. intraoperative tumor specimens (average=1102, SD=153). 2,160 proteins showed differential expression (fold change <2 or <-2) in DIPG tumor compared to normal brain tissue from the same patient; 763 compared to other tumor types. 67% of previously characterized DIPG CSF proteins were detected in the DIPG tumor tissue proteome.

CONCLUSION: We generated the first comprehensive protein profile of DIPG frozen tumor tissue, demonstrating no significant degradation in proteins obtained postmortem. Tissue validation and comparison to genetic profiles are underway. Proteomic analysis offers a systematic approach to understanding DIPG tumor biology.

36. BRAF-TARGETED THERAPEUTICS IN LOW-GRADE GLIOMAS

Shih-Shan Lang, MD; Angela Sievert, MD, MPH; Katie Boucher, BS; Phillip Storm, MD; Adam Resnick, PhD (Philadelphia, PA)

INTRODUCTION: With limited treatment options for disseminated or progressive pediatric gliomas, there is a critical need for effective targeted therapeutics. Activated BRAF mutations are a hallmark of pediatric gliomas and the KIAA1549-BRAF fusion mutation characterizes most low-grade gliomas. This key genetic event has significantly advanced the establishment of targeted treatments for gliomas.

METHODS: As there are no established pediatric low-grade glioma cell lines harboring the KIAA1549-BRAF fusion gene, we engineered a variety of stably expressing BRAF-fusion cell lines. We evaluated the cellular and biochemical targeting of the MAPK (mitogen-activated protein kinase) signaling cascade in these cell lines.

RESULTS: The KIAA1549-BRAF fusion activates the MAPK signaling cascade and is sufficient for malignant cellular transformation and mouse tumor formation. However, cells expressing KIAA1549-BRAF fusion display increased paradoxical activation and drug resistance in response to first generation BRAF-specific inhibitors. In the presence of first generation BRAF-specific inhibitors, KIAA1549-BRAF fusion display increased cellular proliferation, malignant cell transformation, and accelerated mouse tumor growth. Resistance to these BRAF inhibitors is mediated through a MAPK RAF interaction that is specific to and occurs only with the KIAA1549-BRAF fusion. In contrast, treatment with second-generation BRAF inhibitors results in cellular inhibition of the MAPK pathway, decreased proliferation, and decreased malignant cell transformation capacity.

CONCLUSIONS: Our development of pediatric glioma models to study cell signaling pathway interactions of BRAF inhibitors is fundamental in providing the rationale for clinical trials. Our results support the establishment of select, targeted treatment approaches for children afflicted with BRAF-altered gliomas.

37. NEO-ADJUVANT CHEMOTHERAPY IMPROVES SURVIVAL FOR INFANTS WITH EPENDYMOMA: PRELIMINARY RESULTS OF ST. JUDE YOUNG CHILDREN (SJYC07) TRIAL

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INTRODUCTION: Age<3 years and anaplastic histologic features are poor predictors of survival in children with ependymomas. Five-year event free survival is<65%. We prospectively examine the effect of neo-adjuvant chemotherapy (CT) followed by radical surgery, focal radiotherapy (RT) and metronomic oral adjuvant CT on survival outcomes.

METHODS: Twenty-two patients<3 years of age with ependymoma were enrolled on SJYC07 between December 2007 and March 2012. Treatment included 4 identical cycles of induction CT including Methotrexate, Cyclophosphamide, Cisplatin, and Vincristine, followed by focal RT (54 Gy) and 6 months of oral CT.

RESULTS: Patients included 8 females and 14 males (median age 21 months). There were 16 gross total, 5 near and 1 subtotal resections. Fourteen patients had anaplastic histologic features. Seven tumors were midline fourth ventricle, 11 CP-angle and 4 supratentorial. Spine MRI and CSF cytology (when obtained) were negative for metastases. At mean follow-up of 24 months (5-51), one patient developed spinal metastases after 3 months of oral CT. Two patients are on active therapy. One patient experienced a serious adverse event unrelated to chemotherapy. Surgical complications pre-treatment included Grade IV hearing loss (n=1), persistent ataxia (n=2), hemiparesis (n=1), CN VI and VII palsies (n=3) and swallowing dysfunction (n=6).

CONCLUSIONS: These preliminary results suggest that neo-adjuvant chemotherapy (1) is well tolerated in children with ependymoma<3 years, (2) reduces tumor vascularity allowing safer and more aggressive tumor resection and (3) may improve survival as compared to resection/radiation alone.

38. ROLE OF BONE MARROW DERIVED CELLS IN THE TUMOR MICROENVIRONMENT OF MEDULLOBLASTOMA**

Caitlin Elizabeth Hoffman, MD; Karen Badal, MD; Prajwal Rajappa, MD; Yujie Huang, PhD; Jacqueline Bromberg, MD, PhD; David Lyden, MD, PhD; Jeffrey Greenfield, MD, PhD (New York, NY)

INTRODUCTION: Current therapeutic strategies do not universally result in disease control in medulloblastoma. Defining mechanisms of progression may therefore lead to more effective therapeutic approaches. Bone marrow-derived cells (BMDCs) have recently been shown to be integral to the microenvironment of systemic metastatic tumors. BMDC recruitment factors are overexpressed in medulloblastoma, but the role of these cells in the medulloblastoma microenvironment has not been explored. We therefore hypothesized that recruitment of BMDCs to the microenvironment may play a role in medulloblastoma progression.

METHODS: Circulating BMDCs were measured during tumor progression in mouse medulloblastoma models via flow cytometry. Mouse and human tumor sections were stained to evaluate BMDC recruitment, neovascularization, and invasiveness during tumor growth. The Jak2 inhibitor, AZD1480, was used to block BMDC recruitment, and tumor growth, neovascularization, and invasiveness were measured. Effects of AZD1480 on tumor versus BMDC proliferation were controlled.

RESULTS: BMDCs were upregulated within the circulation and the tumor microenvironment in mouse models of medulloblastoma, and were found at the tumor border in human medulloblastoma. Treatment with AZD1480 resulted in decreased circulating BMDCs and decreased BMDC recruitment to the microenvironment. Tumor growth was altered by AZD1480 in vivo, with decreased necrosis, neovascularization, and invasiveness. There was no effect of AZD1480 on tumor cell growth in vitro.

CONCLUSIONS: BMDCs are recruited to the microenvironment in medulloblastoma. Inhibition of this recruitment leads to altered tumor growth without directly effecting tumor cell proliferation. This indicates a role for BMDCs in the support of the medulloblastoma microenvironment, regulating disease progression through a tumor cell-independent mechanism.

39. PSEUDOPROGRESSION OF LOW GRADE GLIOMAS AFTER RADIOTHERAPY

Robert Partlow Naftel, MD; Melvin Deutsch, MD; Regina Jakacki, MD; Ian Pollack, MD (Pittsburgh, PA)

INTRODUCTION: Increasing enhancement and mass effect following radiation therapy in patients with low-grade gliomas (LGG) can be mistaken for tumor progression and/or malignant degeneration. Differentiating this pseudoprogression from true progression is necessary to determine the need for alternative therapy. This study investigates the incidence and timetable pseudoprogression after radiotherapy (RT).

METHODS: Retrospective chart review was performed on children treated with RT for LGG at the Children's Hospital of Pittsburgh Neuro-Oncology program with at least 1 year of follow-up.

RESULTS: Twenty-nine children, median age 12, underwent RT (external beam-21, gamma knife-6). Histologies included juvenile pilocytic astrocytoma (20/29), LGG (5/29), and radiologic diagnosis of LGG (4/29). Seventeen patients developed increased enhancement and/or mass effect following RT with a median time to maximum tumor enlargement of 6 months, with a range of 4 months up to 4.7 years. Ten children were symptomatic and treated with steroids (n=10) and/or avastin (n=3). Three children were operated upon, 2 for cyst fenestration, and one for debulking after concern for true progression; however, pathology showed treatment effect: radiation necrosis with scattered juvenile pilocytic astrocytoma tumor cells. In all 17 cases, the tumor eventually decreased in size without additional antitumor therapy. With a median follow-up of 4.8 years (range 1.0-12.4 years), all patients remain alive and progression free.

CONCLUSIONS: Tumor pseudoprogression was seen in over half of patients with LGG, occurring as long as 4.7 years after radiation. Radiotherapy was universally effective in this population without any evidence of true progression.

40. SYSTEMATIC REVIEW OF THE RESULTS OF SURGERY AND RADIOTHERAPY ON TUMOR CONTROL FOR PEDIATRIC CRANIOPHARYNGIOMA**

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INTRODUCTION: Craniopharyngiomas are rare tumors with bimodal incidence in the pediatric and adult age groups. Treatment strategies range from aggressive resection to planned limited resection combined with adjuvant therapies. Currently there is no consensus for standard of care for pediatric craniopharyngioma.

METHODS: We performed a systematic review of the published literature on pediatric craniopharyngioma. Patients were grouped based on extent of resection into gross total resection, subtotal resection, and biopsy procedures. These groups were compared with respect to tumor control. Chi square was used to compare rates of recurrence. Kaplan-Meier was used to generate progression free survival estimates. Cox proportional hazard modeling was used to evaluate risk of progression. Each extent of resection group was also subdivided based on adjuvant therapy and compared.

RESULTS: A total of 109 studies described extent of resection resulting in a cohort of 531 patients. Recurrence data were available for 377 patients. There was no difference in one-year or five-year progression free survival (PFS) between the groups who underwent gross total resection (GTR) and subtotal resection (STR) combined with radiation (XRT) (log-rank; p=0.76; 1-year PFS 89 vs 84%; 5-year PFS 77 vs 73%, respectively). One-year PFS was 84% for STR+XRT compared to 76% for STR alone while five-year PFS was 73% for STR+XRT compared to 43% for STR alone (log-rank; p = 0.003).

CONCLUSIONS: Although there are limitations of a systematic review of retrospective data, our results suggest that STR+XRT of pediatric craniopharyngioma is associated with similar rates of tumor control as GTR.

41. EFFECT OF SURGICAL DEBULKING ON POST-OPERATIVE CEREBELLAR MUTISM

Anthony Myint; Yasser Jeelani, MD; Jessica Ashford, MS; Stephanie Da Silva, BA; J. Gordon McComb, MD; Mark Krieger, MD (San Marino, CA)

INTRODUCTION: Cerebellar mutism syndrome (CMS) is an established complication of posterior fossa surgery in children. Our study investigates associations between choice of surgical debriding method (ultrasonic aspiration, microdissection, or myriad) and CMS development. We also investigate possible risk factors associated with CMS.

METHODS: An IRB-approved retrospective review was performed on all patients who underwent posterior fossa tumor resection at our institution between 2005 and 2012. Patient charts, radiographic studies, and patient-evaluations by an onsite speech pathologist were reviewed. Patients younger than 2 years or with significant premorbid neurological deficits were excluded from the study due to difficulty in assessing speech.

RESULTS: Of the 86 patients meeting the above criteria, 12 (14%) had post-operative mutism. Average age of onset was 8 years (range 2.5-18.8). Using chi-square independence testing, the following risk-factors were not found to be significantly associated with mutism: pre-operative hydrocephalus, duration of symptoms prior to surgery, choice of tumor-debulking method, vermian tumor location, tumor type, and prolonged post-operative intubation. Ethnicity showed borderline significance (p=0.052). In contrast, age in the 5 to 10 year range, tumor location in the right cerebellar hemisphere, and invasive tumor (necessitating subtotal resection) were found to be significantly associated with CMS.

CONCLUSIONS: Our study suggests that age of 5 to 10 years at time of surgery, tumor location in the right cerebellar hemisphere, and subtotal resection all increase risk of post-operative mutism. Interestingly, our results did not show a correlation between histology, vermian involvement, and resection technique in the development of CMS.

42. FLUORESCENCE-GUIDED RESECTION OF PEDIATRIC CNS NEOPLASMS WITH THE USE OF NOVEL, SAPOSIN C-DIOLEOYLPHOSPHATIDYLSERINE (SAPC-DOPS) NANOVESICLES

Lauren Rose Ostling, MD; Xiaoyang Qi, PhD; Charles Stevenson, MD (Cincinnati, OH)

INTRODUCTION: Real-time, fluorescence-guided resection of malignant gliomas utilizing 5-ALA is being increasingly employed in adult patients, with initial data suggesting greater extent of resection, and, improved survival advantage. However, 5-ALA has inherent limitations as a molecular contrast agent, including relative nonspecificity, weak fluorescence, and poor affinity for nonenhancing tumors. Development of superior compounds, capable of labeling a broad spectrum of tumors, will improve the clinical utility of fluorescence-guided resection. We have engineered a non-toxic, near-infrared fluorescing glycoprotein nanovesicle, SapC-DOPS, that crosses the blood-brain barrier and binds aberrant phosphatidylserine residues on neoplastic cells.

METHODS: To establish relative labeling sensitivity and specificity, tissue sections of multiple pediatric intracranial neoplasms were stained with SapC-DOPS. Tail vein injections of SapC-DOPS were then performed in mice harboring glioblastoma intracranial xenografts. Craniotomy was performed in these mice, and fluorescence microscopy used to visualize and guide tumor resection. Histological analysis of resected specimens was performed to correlate sensitivity and specificity of tumor labeling.

RESULTS: SapC-DOPS was shown to specifically bind glioblastoma cells versus non-neoplastic tissue both in vitro and in vivo. In vivo, tumor labeling was robust and specific, with bright signal enabling tumor resections under real-time fluorescence microscopy, and no detectable fluorescence of adjacent brain parenchyma.

CONCLUSIONS: SapC-DOPS is a non-toxic molecular contrast agent that specifically binds neoplastic cells. It has demonstrated excellent sensitivity and specificity for high-grade gliomas, with current studies examining its affinity for additional brain tumors, including low-grade lesions. Given its potential applicability, SapC-DOPS may be superior to compounds currently used in fluorescent-guided resections of intracranial neoplasms.

43. PROGRESSION OF CRANIOPHARYNGIOMA FOLLOWING CONFORMAL RADIATION

Paul Klimo Jr., MD; Frederick Boop, MD; Kyle Gabrick, BS; Thomas Merchant, MD; Robert Sanford, MD (Memphis, TN)

INTRODUCTION: Management of patients with craniopharyngioma continues to be controversial. Some advocate aggressive surgery. Others, including ourselves, favor less surgery followed by radiation for residual disease.

METHODS: Retrospective review of all patients treated with conformal radiotherapy following surgery for craniopharyngioma treated at St. Jude Children's Hospital. Treatment failure was defined as solid or cystic tumor progression requiring intervention.

RESULTS: Eighty-eight children (median age 8.5 yrs, range 3.2-17.6 yrs) received conformal or intensity-modulated radiation therapy between 1998 and 2009. There were 14 (16%) children that had progressive disease. Time to progression following radiation was 49.7 months. There were 4 (0.4%) deaths, 3 related to progressive disease (1 malignant disease, 2 secondary to treatment) 1 secondary to sepsis in a child with stable residual disease. Of the 14 tumor progressions post radiation 9 developed new cysts and 5 were solid tumor progression. Two of the 5 solid progressions were successfully treated with gross total resection and one with subtotal resection and gamma knife. Of the 9 cystic progressions, 6 were successfully treated with Ommaya reservoir and multiple aspirations with 38-month average follow up, 3 were treated with subtotal tumor+ cyst resection with 32-month follow up. As of this date none have shown solid tumor progression.

CONCLUSIONS: Cystic progression after conformal radiation may not indicate true tumor progression. Management of the cyst alone may significantly palliate these children with low morbidity. Solid tumor progression can be successfully managed with gross total resection.

44. EVALUATION OF A NEW STAGING SYSTEM FOR JUVENILE NASOPHARYNGEAL ANGIOFIBROMAS (JNA)

Kimberly Anne Foster, MD; Carl Snyderman, MD; Eric Wang, MD; Carlos Pinheiro, MD; H Pant, MD; Juan Fernandez-Miranda, MD; Paul Gardner, MD; Elizabeth Tyler-Kabara, MD, PhD (Pittsburgh, PA)

INTRODUCTION: JNA is a benign vascular tumor that behaves in a locally aggressive manner with associated intracranial extension. Multiple staging systems exist, but do not account for route of intracranial extension or tumor vascularity.

METHODS: We retrospectively reviewed JNAs at our institution to evaluate prognostic factors for recurrence and develop a new staging system.

RESULTS: Forty patients underwent surgical resection of JNA; all were male with average age of 14 years. All (100%) underwent preoperative embolization. Mean follow-up was 50 months; 11 patients had evidence of recurrent disease with 6 requiring repeat intervention. The UPMC staging system was devised based on anatomical involvement of tumor and vascularity following embolization. Stage I: nasal cavity, medial pterygopalatine fossa. Stage II: paranasal sinuses, lateral pterygopalatine fossa and no residual vascularity. Stage III: skull base erosion, orbit, infratemporal fossa and no residual vascularity. Stage IV: skull base erosion, orbit, infratemporal fossa with residual vascularity. Stage V: intracranial extension with residual vascularity (V-M: medial extension; V-L: lateral extension). Blood loss for UPMC stages IV/V (2240 +/- 2272ml) was significantly greater than UPMC stages I/II/III (318 +/- 178ml) (p=0.001). No patients in the UPMC Stage I/II (n=8) showed evidence of recurrence or required repeat surgery. No patient required adjuvant radiation.

CONCLUSIONS: Goals of treatment of JNA are complete surgical resection and avoidance of radiation therapy. The UPMC Staging System incorporates prognostic factors not addressed by prior systems: route of extension and residual vascularity following embolization. Route of extension is an important consideration in selecting optimal surgical approach.

45. DECISION ANALYSIS OF TREATMENT OPTIONS FOR PEDIATRIC CRANIOPHARYNGIOMAS

Lawrence Daniels, MD; Zarina S. Ali, MD; Robert Bailey, MD; John Lee, MD; Phillip Storm, MD; Sherman Stein, MD; Gregory Heuer, MD, PhD (Philadelphia, PA)

INTRODUCTION: With advancements in the supportive care and radiation treatment for children with craniopharyngioma, outcome assessments are focusing on quality of life rather than mortality.

METHODS: We developed a decision analytic model to evaluate outcomes of four surgical approaches to craniopharyngioma in children, including: attempted gross total excision, planned subtotal removal plus radiotherapy, biopsy plus radiotherapy, and endoscopic excisions of all kinds. The model projects quality-adjusted life years (QALYs) from data derived from a critical review of published reports. Pooled data were used to calculate the incidence, relative risks and summary outcomes for the four management strategies.

RESULTS: Using these values in a Monte Carlo simulation of a series of virtual randomized clinical trials yielded QALYs at 5-year follow-up of 2.3 +/- 0.1 for attempted gross total excision, 2.9 +/- 0.2 for planned subtotal removal plus radiotherapy, 3.9 +/- 0.2 for biopsy plus radiotherapy, and 3.7 +/- 0.2 for endoscopic resection ($F = 17,150$, $p < 0.001$). Similarly, QALYs at 10-year follow-up were 4.5 +/- 0.2 for attempted gross total excision, 5.7 +/- 0.5 for planned subtotal removal plus radiotherapy, 7.8 +/- 0.5 for biopsy plus radiotherapy ($F = 6,173$, $p < 0.001$). Follow-up data at ten years is lacking for endoscopic cases.

CONCLUSIONS: Biopsy with subsequent radiotherapy is the preferred approach with respect to improved overall quality of life. Endoscopic resection may also provide similar outcome, but long-term data are currently limited. This meta-analysis is inherently limited by aggregating the retrospective experience of multiple centers with different surgical experiences.

46. PSEUDOPROGRESSION IN THE PEDIATRIC BRAIN TUMORS**

Chester Kossman Yarbrough, MD; Aravind Somasundaram, BS; Jeffrey Leonard, MD (St. Louis, MO)

INTRODUCTION: Treatment of pediatric brain tumors often employs a multimodality strategy including surgery, radiation, and chemotherapy. In adult glioma patients, development of treatment-induced contrast enhancement soon after chemotherapy and radiation has been well-documented. This phenomenon has not been studied in depth in the pediatric population.

METHODS: Patients undergoing initial resection of pediatric low and high grade primary brain tumors between 2004 and 2012 were identified via our institutional neuro-oncology database. Treatments and radiographic images were reviewed, and the patients who suffered from pseudoprogression were identified for further study. Data was analyzed separately for patients harboring low (WHO I and II) and high (WHO III and IV) grade tumors.

RESULTS: 4.4% (6/137) of low grade and 12.5% (7/56) of high grade patients exhibited pseudoprogression. Radiographic changes occurred 3.3 months and 4.3 months after radiation treatment and resolved after 10.1 and 10.5 months in low and high grade patients, respectively.

CONCLUSIONS: Pseudoprogression is an important phenomenon to recognize in pediatric patients undergoing chemoradiation for low and high grade tumors. There does not appear to be a significant difference in behavior of pseudoprogression between low and high grade patients, provided that similar radiation paradigms are used. The lower incidence of pseudoprogression in low grade patients is likely due to less utilization of adjuvant therapies in those patients.

47. DOES THE PRESENCE OR DEVELOPMENT OF HYDROCEPHALUS AFFECT THE PROGNOSIS FOR DIFFUSE INTRINSIC PONTINE GLIOMA?

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INTRODUCTION: Diffuse Intrinsic Pontine Gliomas (DIPG) are high-grade tumors that are locally infiltrative, and have a uniformly poor prognosis despite aggressive therapy. Development of hydrocephalus in patients with DIPG is common but little research exists correlating the incidence and progression of hydrocephalus to general outcome in these children.

METHODS: In this IRB-approved study, 41 children with DIPG from 2000 to 2011 were retrospectively reviewed. Serial MRIs and CTs were evaluated for disease course and presence of hydrocephalus.

RESULTS: The average age was 8.1 years and 26 (61%) were female. The average overall survival (OS) of the group was 11.3 months. Children under 3 years of age had shorter average survival than older children (5.2 vs 12 months, p=0.05). 33 received radiation and 27 were treated with chemotherapy. 23 patients (56%) had hydrocephalus; 9 had it at presentation and 14 developed it in a delayed fashion. The average OS for patients with hydrocephalus at presentation was 13.7 months vs. 11.8 months for patients without hydrocephalus at presentation (p = 0.52). Patients who developed hydrocephalus in a delayed fashion (median delay 7.13months), had a median survival of 8.7 months from the time of treatment of the hydrocephalus.

CONCLUSIONS: The presence of hydrocephalus at the time of diagnosis of DIPG did not affect prognosis in this series. Substantial survival is possible after the presentation of hydrocephalus; this information should be useful in determining the utility of treating the hydrocephalus and in counseling patients and their families.

48. MORBIDITY AND NEUROLOGICAL OUTCOMES FOLLOWING REPEAT SURGICAL RESECTION OF PEDIATRIC INTRAMEDULLARY TUMORS**

Raheel Ahmed, MD; Arnold Menezes, MD (Iowa City, IA)

INTRODUCTION: Management of recurrent or progressive intramedullary tumors poses significant challenges given the potential morbidity of surgical resection and risk of secondary deformity. Moreover, the respective roles of chemotherapy and radiotherapy are not well established. We reviewed our institutional experience in management of recurrent pediatric intramedullary tumors, focusing on patients who underwent repeat surgical resection.

METHODS: Case records for pediatric patients (<21yr), treated at our institution for IMSCTs were analyzed. Patient demographics, treatment and outcome variables were examined.

RESULTS: Of a total of 55 patients (<21yr) with pediatric IMSCTs identified between 1975 and 2010, 15 patients (27%) underwent repeat surgical resection. Average age (9 yr) in this group was not significantly different from the remainder study group (10yr). Low grade histological subtypes were more predominant in the repeat surgery group (p-value <0.01). The proportion of patients who underwent gross total versus subtotal resection was not significantly different between the two groups. Median survival was significantly lower in repeat surgery group (median = 10yr) as compared to single surgery group (median = 29yr; p-value <0.05). Similarly, patients in repeat surgery group where more likely to demonstrate decline in McCormick functional grade over their clinical course (p-value <0.01).

CONCLUSIONS: Low grade tumors comprise the majority histological subtype in patients undergoing repeat surgical resection. Despite their benign biological behavior, low grade tumor often exhibit significant long term morbidity secondary to progression or recurrence.

49. GREATER EXTENT OF RESECTION IMPROVES PROGRESSION-FREE SURVIVAL IN CHILDREN WITH GANGLIOGLIOMAS: A VOLUMETRIC ANALYSIS

Devon H. Haydon, MD; Jeffrey Leonard, MD (St. Louis, MO)

INTRODUCTION: Gangliogliomas are indolent tumors but can recur with varying frequency. Although some consider extent of resection (EOR) a predictor of clinical outcome, earlier studies assess EOR by an all-or-nothing, complete vs. incomplete classification. This study uses a volumetric analysis to identify a specific ganglioglioma EOR threshold which predicts improved progression-free survival (PFS) in children.

METHODS: Clinical records were retrospectively reviewed from St. Louis Children's Hospital. Patients were included if they were <20 years at diagnosis of a WHO grade I ganglioglioma, received surgery alone, and had accompanying volumetric imaging and survival data.

RESULTS: Twenty-three children (11 males, 12 females) were identified with a mean age at diagnosis of 13 years. The temporal lobe was most frequently involved (15 cases). Preoperative tumor volume was 9.3 cm3 (range 0.3 – 61.1). Mean EOR was 95.6% (range 64.7 - 100) while mean residual tumor volume was 0.5 cm3 (range 0 – 3.7). Five tumors recurred an average of 14.2 months following diagnosis (range 5.3 – 27.7). Improved PFS was observed for lesions with ≥94% EOR (p=0.027). Residual tumor volume <1.6 cm3 was also associated with prolonged PFS (p<0.001). Mean duration of follow-up was 31.3 months (range 4.5 – 104.7).

CONCLUSIONS: EOR ≥94% and residual tumor volume <1.6 cm3 are associated with improved PFS in children with gangliogliomas. These data indicate that even a thorough, subtotal resection can improve clinical outcome. Cytoreductive surgery should be offered for newly diagnosed gangliogliomas in children when safely feasible.

50. QUALITY MEASURES FOR THE MANAGEMENT OF HYDROCEPHALUS: CONCEPTS, SIMULATIONS, AND PRELIMINARY FIELD TESTING

Joseph H. Piatt Jr., MD; Spencer Barton; Jeffrey Campbell, MD
(Merion Station, PA)

INTRODUCTION: We define and examine the properties of 2 new, practice-based quality measures for the management of hydrocephalus.

METHODS: The Surgical Activity Rate [SAR] is defined as the number of operations for hydrocephalus performed in a neurosurgical practice over the course of a year divided by the number of patients with hydrocephalus seen in follow up during that year. The Revision Quotient [RQ] is defined as the number of revision operations performed in a neurosurgical practice in the course of a year divided by the number of initial operations for patients with new diagnoses of hydrocephalus. Employing published shunt survival data, Monte Carlo simulations were conducted to illustrate the properties of the SAR and the RQ. Employing data from the Kids' Inpatient Database [KID] for 2009, RQs were calculated for hospitals with more than 10 admissions for initial CSF shunt insertions.

RESULTS: During the growth phase of a simulated practice, the SAR approached its steady state value earlier than the RQ. Both measures were sensitive to doubling or halving of monthly failure rates. In the 2009 KID 117 hospital accounted for more than 10 initial shunt insertions. The weighted mean [SD] RQ was 1.79 [0.69]. Among hospitals with 50 or more initial shunt insertions, the RQ ranged between 0.71 and 3.65.

CONCLUSIONS: The SAR and the RQ have attractive qualitative features as practice-based quality measures. The RQ exhibits clinically meaningful interhospital variation. The SAR and the RQ merit prospective field testing.

51. FOURTH VENTRICULAR SHUNT SURVIVAL COMPARING PARIETAL STEREOTACTIC ENDOSCOPIC TRANSTENTORIAL AND SUBOCCIPITAL APPROACHES**

Sarah Tamara Garber, MD; Frank Bishop, MD; Douglas Brockmeyer, MD; Jay Riva-Cambrin, MD (Salt Lake City, UT)

INTRODUCTION: Traditional management of loculated fourth ventricular hydrocephalus consists of suboccipital fourth ventricular shunt (FVS) placement. Alternatively, a parietal stereotactically-guided endoscopic transtentorial approach to the fourth ventricle can be used. This study compares the shunt survival and revision rates between these two approaches.

METHODS: We retrospectively reviewed 29 consecutive patients who underwent FVS placement from January 1st, 1998 through December 31, 2011 either via the suboccipital (SO) or parietal stereotactic endoscopic transtentorial approach (PSET). The primary study variable consisted of the original FVS placement as well as the first cross-over procedure to the other approach if performed. Our primary outcome was shunt failure defined as the number of days to first shunt revision or removal (obstruction or infection).

RESULTS: There was a statistically significant difference in time to failure with the PSET shunts lasting an average of 901 days vs. 122 days for the SO technique ($p = .04$). There was also a significant difference in the rate of crossover with 1 PSET to SO shunt (5.6%) and 5 SO to PSET shunts (45.5%). The etiology of fourth ventricular hydrocephalus and the neurosurgeon performing the procedure were not statistically significant in this study.

CONCLUSIONS: Parietal stereotactically-guided endoscopic transtentorial FVS placement resulted in significantly longer shunt survivals and lower revision rates than the traditional suboccipital approach, despite a higher rate of crossover from previously failed shunting procedures. PSET shunt placement may be considered an option for patients with loculated fourth ventricular hydrocephalus, particularly when shunt placement via the standard suboccipital approach fails.

52. VENTRICULOMEGALY DIAGNOSED ON FETAL MRI AND THE RISK OF POST-NATAL HYDROCEPHALUS

Matthew Kole; Jennifer Williams, MD; Angel Krueger; Debora Ybarra; William Whitehead, MD; Christopher Cassady, MD; Robert Bollo, MD (Houston, TX)

INTRODUCTION: Ventriculomegaly is among the most common anomalies diagnosed by fetal MRI. Limited data suggests severe ventriculomegaly is associated with a high risk of post-natal hydrocephalus, however the specific nature of this correlation remains unclear.

METHODS: We performed a retrospective cohort analysis of 81 maternal-fetal dyads diagnosed with ventriculomegaly by fetal MRI over a ten-year period [2003-2012]. Patients were included if at least one lateral ventricle atrial diameter [AD] measured $\geq$ 10 mm (mean 15 mm) and $\geq$ 3 months of post-natal follow-up data was available (mean 26 months). We assessed the relationship between gestational age, fetal sex, AD for each lateral ventricle, the presence of other CNS anomalies, and post-natal hydrocephalus requiring surgical treatment.

RESULTS: Mean gestational age at the time of fetal MRI was 27.3 weeks. 47 fetuses (58%) were male. In 34 cases (42%), no additional CNS anomalies were identified. Fifteen cases (19%) developed post-natal hydrocephalus. Mean AD was 23 ± 7 mm in these cases, vs. 14 ± 4 mm in fetuses who did not develop hydrocephalus ($p < 0.001$). Excluding patients with myelomeningocele (n=26) and Dandy-Walker malformation (n=2), 3% (1/29) of patients with largest AD < 15 mm underwent surgery for hydrocephalus, compared to 65% (11/17) with one AD $\geq$ 20 mm and 86% (6/7) with one AD $\geq$ 30 mm.

CONCLUSIONS: Severe ventriculomegaly on fetal MRI (one AD $\geq$ 20 mm) appears strongly associated with post-natal hydrocephalus. Conversely, in the absence of specific CNS anomalies, mild fetal ventriculomegaly (AD < 15 mm) is not.

53. ABNORMAL DEVELOPMENT OF NG2+PDGFRA+ NEURAL PROGENITOR CELLS CAUSES NEONATAL HYDROCEPHALUS

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INTRODUCTION: Congenital hydrocephalus is a common neurological disorder leading to the expansion of the cerebral ventricles and is associated with significant morbidity and mortality. The majority of neonatal cases are of unknown etiology. Identifying molecular mechanisms responsible for neonatal hydrocephalus and developing novel treatment modalities are high priorities.

METHODS: We employed a hydrocephalic mouse model of the human ciliopathy Bardet-Biedl Syndrome-(BBS) to identify a role for neural progenitor cells in the pathogenesis of neonatal hydrocephalus. We also identified human BBS patients with known BBS mutations who had ventriculomegaly similar to those observed in the BBS mouse model.

RESULTS: We found that hydrocephalus in this mouse model is caused by aberrant PDGFRα signaling, resulting in increased apoptosis and impaired proliferation of NG2+PDGFRα+ neural progenitor cells. Conditional knockout of Bbs1 in this progenitor cell population lead to neonatal hydrocephalus and confirmed the involvement of NG2+PDGFRα+ progenitor development. Hydrocephalus in these conditional knockout mice developed in the presence of normal motile cilia challenging the conventional view that motile cilia are crucial in the pathogenesis of hydrocephalus. Targeting the defective PDGFRα signaling pathway with novel agents rescued progenitor cell development resulting in reduced ventricular volume and improved functional outcomes.

CONCLUSIONS: Our findings indicate that abnormalities in a subset of neural progenitor cells play a crucial role in the pathogenesis of neonatal hydrocephalus similar to those seen in human patients. Importantly, we identify novel therapeutic targets for altering the severity of hydrocephalus. We also identify a novel role for BBS1 in mediating the PDGFRα signaling pathway.

54. DECORIN REDUCES VENTRICULOMEGALY AND SUBARACHNOID FIBROSIS IN JUVENILE RATS WITH COMMUNICATING HYDROCEPHALUS

James P. (Pat) McAllister II, PhD; Hannah Botfield, MS; Anders Skjolding, MD; Ana Gonzalez, PhD; Osama Abdullah, MS; Martin Berry, PhD; Ann Logan, PhD (Salt Lake City, UT)

INTRODUCTION: Subarachnoid fibrosis, especially in the basal cisterns, often causes chronic communicating hydrocephalus. Decorin, a Transforming Growth Factor-beta antagonist, reduces scarring in brain and spinal cord lesions; therefore, we hypothesized that Decorin could have therapeutic potential in pediatric communicating hydrocephalus.

METHODS: Three-week old rats received kaolin injections into the basal cisterns to induce subarachnoid fibrosis and communicating hydrocephalus. At the same time, recombinant human Decorin or vehicle were infused into the lateral ventricle continuously for 14 days via osmotic minipumps. MRI was used to evaluate ventricular volumes at 14 days and fibrosis and inflammation was characterized with immunocytochemistry.

RESULTS: Laminin and fibronectin immunostaining demonstrated that fibrosis was prevalent at the site of kaolin injections but nowhere else in hydrocephalic brains. Decorin staining was localized to the ependyma throughout the ventricular system, epithelial cells of the choroid plexus, and within the subarachnoid spaces, confirming that it was distributed throughout the CSF. Hydrocephalic animals with or without vehicle infusion had significantly enlarged ventricles compared to controls ($p<0.05$) and conspicuous fibrosis in the basal cisterns. Rats receiving kaolin + Decorin infusions had significantly reduced ventricular volumes ($p<0.05$).

CONCLUSIONS: These results strongly suggest that Decorin may have the potential to ameliorate ventriculomegaly by reducing fibrosis in the subarachnoid spaces, and thus could be a promising therapeutic candidate for treating hydrocephalus.

55. FRONTAL VERSUS PARIETAL CSF SHUNTS AND SHUNT SURVIVAL, AN HCRN STUDY

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INTRODUCTION: There is conflicting data in the literature regarding the effect shunt entry site has on shunt survival. The study objective was to determine if ventricular catheter entry site (frontal v. parietal) for first-time CSF shunt insertions affects shunt survival.

METHODS: Patients from 3 prospective, multi-centered trials with similar methodologies (shunt design trial, n=344; endoscopic shunt insertion trial, n=393; ultrasound guided shunt insertion study, n=121) were combined and classified based on ventricular catheter entry site. All patients were less than 18 years old with new onset of hydrocephalus.

RESULTS: Three hundred shunts (35.0%) were placed with a frontal approach; 550 shunts (64.1%) were placed from a parietal approach. Data was missing in 8 patients (0.9%). There was no significant difference between the 2 groups with respect to age and etiology of hydrocephalus. Frontal shunts resulted in a one-year shunt survival rate of 70.6% and a two-year survival rate of 63.1%. Parietal shunts resulted in a one-year survival rate of 58.2% and a two-year survival rate of 45.7% (Mantel-Haenszel Log rank test, $p<0.001$). Median survival time for frontal shunts was 3.09 years (95%CI: 2.27, 3.90) and for parietal shunts was 1.64 years (95% CI: 1.21, 2.08). There was not a significant difference in the rate of shunt infection (frontal 10.0%; parietal 9.3%).

CONCLUSIONS: For first-time shunt insertions there appears to be a survival advantage when ventricular catheters are placed using a frontal approach, but the study design cannot account for all confounders. The significance of this finding supports a randomized trial.

56. THE RISK FACTORS FOR AND THE INFLUENCE OF HYDROCEPHALUS ON NEUROLOGICAL OUTCOME IN CHILDREN BORN WITH AN ENCEPHALOCELE

Stephanie Louise Da Silva; Yasser Jeelani, MD; Andrew Yousef; Mark Krieger, MD; J. Gordon McComb, MD (Los Angeles, CA)

INTRODUCTION: There is a known association of hydrocephalus with encephaloceles. Risk factors for hydrocephalus and the neurological outcome were reviewed in our series of patients born with an encephalocele.

METHODS: Under IRB approval, a retrospective analysis was undertaken of patients treated for encephaloceles at a single institution between 1994 and 2012.

RESULTS: 70 children (38 female) were identified. The median age at presentation was 2 months. Mean follow-up was 2.5 years. Location was occipital (35 children) occipitoparietal (13), frontal (10), parietal (7), and basal (5). The average size was 4cm (range 0.5-23cm). Forty-seven contained neural tissue. Ten infants presented at birth with CSF leaking from the encephalocele, with one being infected. Six patients presented with hydrocephalus while 11 developed hydrocephalus post-operatively. The following factors were found to have a statistically significant association with hydrocephalus: presence of neural tissue($p=0.03$), larger size($p=0.007$), location posterior to the coronal suture($p=0.03$), and the presence of other CNS anomalies($p=0.007$). Fourteen had severe developmental delay, 9 moderate, and 19 mild; 28 patients were neurologically normal. Encephaloceles of greater than 2 cm diameter and presence of hydrocephalus had a high incidence of developmental delay ($n=34/49$, $p=0.02$ and $n=17/17$, $p=0.0001$, respectively).

CONCLUSIONS: The incidence of hydrocephalus in children born with encephaloceles is influenced by presence of neural tissue, size, posterior location, and the presence of other associated CNS anomalies. In contrast to the modestly good neurological outcome in children with an encephalocele without hydrocephalus, the presence of hydrocephalus resulted in a far worse outcome.

57. LIMITED SEQUENCE HEAD CT ANALYSIS FOR CHILDREN WITH SHUNTED HYDROCEPHALUS**

Jonathan A. Pindrik, MD; Edward Ahn, MD; Aylin Tekes, MD; Thierry Huisman, MD (Baltimore, MD)

INTRODUCTION: Diagnostic head computed tomography (CT) imparts risks of radiation toxicity. Children with shunted hydrocephalus exhibit increased risk of exposure due to thinner torsos, immature tissues, and frequent scanning. Techniques to reduce radiation toxicity from head CT include decreasing the number of axial slices.

METHODS: Consistent sequences of 7 axial slices were extracted from head CT scans of children with shunted hydrocephalus but no history of intracranial mass lesions. Chronologically distinct scans of each patient were blindly, retrospectively reviewed by two pediatric radiologists and one pediatric neurosurgeon. Limited CT sequence evaluation focused on adequacy of portraying the ventricular system, caliber, and catheter. Reviewers assessed the original head CT scans of each patient over 4 months later for comparison.

RESULTS: Two serial head CT scans from each of 50 patients (age range 0-17 years; mean age 5.5 years) were reviewed. The extracted limited sequences of axial slices adequately portrayed the ventricular system in all cases. The inaccuracy rate for assessing changes in ventricular caliber by majority assessment (2 out of 3 reviewers) was below 8.0%. Inaccuracies involved scans showing diminutive changes in ventricular size. The limited CT sequences displayed the ventricular catheter in 91.7% of scans.

CONCLUSIONS: Limited sequences of axial head CT scans retain clinical utility while reducing radiation toxicity in children with shunted hydrocephalus. This sequence of axial slices can be implemented into a low dose head CT protocol indicated for shunted pediatric patients during follow-up or with low clinical suspicion of shunt malfunction.

58. SIGNIFICANT SHUNT OBSTRUCTION CAUSED BY PARENCHYMAL TISSUE SHEARING DURING VENTRICULAR CATHETER IMPLANTATION**

Jayant Prasanna Menon, MD; Kathryn Olson; Jon Dunbar, BS (San Diego, CA)

INTRODUCTION: Proximal ventricular shunt obstruction is the most common cause of shunt failure. Short-term failure is often attributed to choroid plexus obstruction and little attention has been given to obstruction associated with catheter placement. Upon in vitro examination of proximal catheters of VP shunts, 87% of holes are obstructed immediately post-insertion.

METHODS: A clear walled chamber was pressurized to 25mmHg using a constant infusion of water. Lamb brain was used to simulate the 5cm of cortex that is passed through during a standard ventricular catheter placement. High-resolution photographs were used to document the location and number of patent holes in 20 independent catheter placements. An improved stylet was engineered to reduce the amount of brain obstruction and was tested under the same conditions.

RESULTS: Over 87% of ventricular shunt catheter holes (20.8 of 24) were obstructed upon implantation, although the obstruction did not prevent fluid drainage. Holes closest to the tip of the catheter were most likely to be obstructed. The improved stylet provided 2.7x as many patent holes as the standard stylet, 8.6 compared to 3.2 (p-value = 0.000004).

CONCLUSIONS: Shearing of brain parenchyma into ventricular catheters during insertion obstructs most of the drainage holes. An improved stylet reduces tissue shearing and provides significantly more patent catheter holes. Additional patent holes upon implantation is likely to reduce short-term ventricular catheter failures and improve long-term performance of shunt catheters by providing more unobstructed fluid pathways.

59. ROLE OF ENDOSCOPIC THIRD VENTRICULOSTOMY AND CHOROID PLEXUS COAGULATION IN POST HEMORRHAGIC HYDROCEPHALUS OF PREMATURITY

Parthasarathi Chamiraju, MD; David Sandberg, MD; John Ragheb, MD; Sanjiv Bhatia, MD (Miami, FL)

INTRODUCTION: To determine the role of endoscopic third ventriculostomy and choroid plexus coagulation (ETV/CPC) in patients with post hemorrhagic hydrocephalus of prematurity and to analyze factors which affect patient outcomes.

METHODS: We retrospectively reviewed medical records of 27 premature infants with intraventricular hemorrhage and hydrocephalus treated with ETV/CPC between 2008-2011. All patients had pre operative MRI and underwent endoscopic third ventriculostomy, septostomy and bilateral choroid plexus coagulation when feasible. These patients were followed over a period of 6-40 months (mean-16.4 months). The procedure was considered a failure if the patient subsequently required a shunt. The following factors were analyzed to determine a possible relationship to outcomes: gestational age, age and weight at the time of surgery, severity of intraventricular hemorrhage and prior need for reservoir placement.

RESULTS: Seventeen (63%) out of 27 patients required a shunt procedure after ETV/CPC and 10 patients (37%) did not require subsequent CSF diversion. A few patient and radiological factors were associated with failed ETV/CPC: Grade IV hemorrhage, weight under 3 kg, age less than 3 months at surgery and previous reservoir placement. The majority (82%) of ETV/CPC failures occurred in initial 3 months and no patient had a complication directly related to the procedure.

CONCLUSIONS: ETV/CPC may be considered as a safe initial procedure for hydrocephalus in premature babies with IVH and hydrocephalus in spite of low success rate to avoid shunt and its complications. As above factors studied may influence outcome, we believe that careful selection of patients for this procedure might increase the success rate.

60. THE ASSOCIATION BETWEEN RACE AND MALIGNANT SHUNT FAILURE

Robert Partlow Naftel, MD; Nicole Safiano, BS; Michael Falola, MD, MPH; Jeffrey Blount, MD; W. Oakes, MD; John Wellons, MD, MPH (Pittsburgh, PA)

INTRODUCTION: Children experiencing frequent shunt failure, i.e., malignant shunt failure, consume medical resources and represent a disproportionate level of morbidity in hydrocephalus care. While biologic causes of malignant shunt failure may exist, this study analyzed demographic and socioeconomic patient characteristics associations with malignant shunt failure.

METHODS: A survey of 294 caregivers of children with shunted hydrocephalus provided demographic and socioeconomic characteristics. Children experiencing ≥10 shunt failures were considered malignant shunt failure patients. Multivariate regression models were used to control for variables.

RESULTS: Malignant shunt failure was experienced by 9.5% (28/294). By univariate analysis, white race (p=0.006), etiology of hydrocephalus (p=0.022), years-with-shunt (p<0.0001), and surgeon (p=0.02) were associated with malignant shunt failure. Upon multivariate analysis, white race remained the key independent factor associated with malignant shunt failure, OR 5.8 (95%CI 1.2-27.8), p=0.027. Race acted independently from socioeconomic factors, including income, level of education, and geographic location, and clinical factors such as etiology of hydrocephalus, surgeon, and years-with-shunt. Additionally, after multivariate analysis surgeon and years-with-shunt remained associated with malignant shunt failure (p=0.043 and p=0.0098, respectively), although etiology of hydrocephalus was no longer associated (p=0.1).

CONCLUSIONS: White race was the primary independent factor associated with malignant shunt failure. Because races utilize healthcare differently and the diagnosis of shunt failure is often subjective, disparity in diagnosis and treatment have arisen. These findings beckon objective criteria for the preoperative and intraoperative diagnosis of shunt failure.

61. VISUAL FINDINGS IN CHILDREN WITH SHUNTED HYDROCEPHALUS

Julian J. Lin, MD; Lasun Oladeji, BA; Ahmad Issawi, MD; Lynn Lyle, RN (Peoria, IL)

INTRODUCTION: Children with shunted hydrocephalus often have abnormal visual findings. This study aims to assess ophthalmologic findings in children with shunted hydrocephalus and specifically whether abnormal eye findings lead to shunt revision surgeries.

METHODS: Retrospective review of the electronic medical records in pediatric patients shunted for hydrocephalus between 2003-2012.

RESULTS: One hundred twenty-nine children in whom a shunt was implanted were included in this study. There were 73 male; mean age was 5.45. Approximately one third of hydrocephalus was post hemorrhagic, one third due to neural tube defects and one third congenital. All children underwent extensive ophthalmologic examination to determine visual acuity as well as the presence of various ophthalmological disorders such as strabismus and amblyopia. Visual function deficits were observed in 74% (95/129) of children and 38% had multiple deficits. Of the deficits noted, strabismus (10), amblyopia (14), disconjugate gaze (32), and papilledema (3) were the most common. Corrective lenses were recommended in 21% of the patients examined, while 60% of patients with strabismus required surgery. Visual field deficits resulted in shunt revision in only one instance, and that was due to papilledema.

CONCLUSIONS: Children with shunt-treated hydrocephalus display a high incidence of ophthalmological dysfunction, however this does not appear to be indicative of the need for shunt revision. Considering the prevalence of visual field deficits in this population, it would be prudent to recommend an ophthalmologist consult for all children with shunted hydrocephalus.

62. ROLE OF PRIMARY CILIA IN DEVELOPING CHICK EMBRYOS

Takayuki Inagaki, MD; Gary Schoenwolf, PhD (Salt Lake City, UT)

INTRODUCTION: Impairment of cilia function underlies a number of human diseases including neural tube defect and hydrocephalus. However, the role of cilia in the developing embryo is not well understood. Chloral hydrate is known to have an adverse effect on the cilia formation. In this paper, the possible role of cilia in developing chick embryos will be described mainly by focusing on the formation of the central nervous system.

METHODS: White Leghorn chicken eggs were incubated until embryos reached Hamburger and Hamilton stages 4 to 10. Embryos were then removed from the shell and cultured on agar plates. After staging, embryos were treated with a chloral hydrate solution for 20 minutes, and reincubated. Embryos were collected from the incubator and examined morphologically after approximately 24 hours.

RESULTS: Embryos treated with chloral hydrate developed neural tube defects, reversed-sided heart looping, and an abnormally shaped primitive cerebral ventricle in a dose-dependent manner.

CONCLUSIONS: The importance of motile cilia in normal function of the ventricular system, including its role in circulation of cerebrospinal fluid, is widely recognized, but the role of primary cilia in early embryonic development is not well understood. In this study we found that embryos treated with chloral hydrate have reversed-sided heart looping, suggesting that chloral hydrate alters the function of primary cilia, which are known to play a role in establishing sidedness. Our results suggest that cilia also have an important role in early development of the central nervous system, in addition to a role in axial development.

63. OMMAYA VENTRICULAR RESERVOIR VERSUS VENTRICULOSUBGALEAL SHUNT FOR POSTHEMORRHAGIC HYDROCEPHALUS: INFECTION RISKS AND VENTRICULOPERITONEAL SHUNT RATES

Joanna Wang, BA; Anubhav Gautam Amin; Vivek Mehta, MD; Benjamin Carson, MD; George Jallo, MD; Edward Ahn, MD (Baltimore, MD)

INTRODUCTION: Posthemorrhagic hydrocephalus (PHH) in preterm infants often results in poor developmental and neurological outcomes. The Ommaya ventricular reservoir (OVR) and the ventriculosubgaleal shunt (VSGS), temporary devices used to treat hydrocephalus before permanent insertion of a ventriculoperitoneal (VP shunt), were reviewed.

METHODS: We retrospectively analyzed 92 patients with IVH and PPHVD who were treated with insertion of an OVR (n = 46) or VSGS (n = 46) at our institution from 1998 to 2011.

RESULTS: The gestational age and weight at device insertion was lower for VSGS patients (mean 30.1weeks, 1120g) than for OVR patients (32.3weeks, 1384g; p=0.001, p=0.002, respectively). OVR insertion was independently predictive of more CSF taps prior to VP shunt placement compared to VSGS placement (9.7taps, 1.6taps, respectively; p<0.001) and OVR patients had higher rates of positive CSF cultures compared to VSGS patients (22%, 6.5%, respectively; p<0.036). VSGS patients experienced a longer postponement of VP shunt placement than OVR patients (80.8days, 48.0days, respectively; p=0.002), which corresponded to VSGS patients attaining more weight at the time of shunt placement than OVR patients (3.3kg, 2.5kg, respectively; p<0.01). However, there were no differences in the rates of overt device infection requiring removal, VP shunt insertion, or early VP shunt infection between the two cohorts.

CONCLUSIONS: VSGS were inserted in more prematurely born patients and at lower weights compared to OVR. VSGS requires less invasive management by manual CSF removal, lower rates of positive CSF cultures, and allows patients to attain higher weight before VP shunt insertion. Long-term cognitive and neurological implications warrant further study.

64. PERCUTANEOUSLY-PLACED VENTRICULO-ATRIAL SHUNTS VERSUS VENTRICULO-PERITONEAL SHUNTS: BRINGING BACK AN OLD TECHNIQUE

Tyler Amina; Robert Keating, MD; Ameet Chitale, MD; John Myseros, MD; Amanda Yaun, MD; Bhupender Yadav, MD; Suresh Magge, MD (Washington, DC)

INTRODUCTION: Ventriculoperitoneal shunts (VPS) have been established as the preferred treatment for hydrocephalus. The advent of percutanously-placed ventriculoatrial shunts (percVAS) has raised the question of long-term outcomes between VP and VA shunts. There have been no recent studies comparing these treatments in children.

METHODS: Retrospective, IRB-reviewed study of 335 pediatric patients treated with a new VPS or percVAS from 2000-2010. Age, etiology, failure rate (infectious/non-infectious), number of revisions, and reasons for failure were analyzed with standard statistical methods.

RESULTS: There were 63 new percVAS and 300 new VPS. Follow-up was 3.96 years and 4.92 years for VPS and percVAS respectively. Almost all patients receiving a percVAS previously had had a VPS. Infection rate for VPS was 8.3% compared to 2% for percVAS (p<0.005). Acute failure rate for VPS versus percVAS was 41% and 37% respectively (excluding elective lengthenings) (p=0.56). Kaplan-Meier estimates did not reveal a significant difference in time to failure (p<0.2422). However, percVAS patients had a significantly better time to failure compared to VPS patients with at least one prior revision (p<0.01).

CONCLUSIONS: These data show that percVAS had a significantly lower infection rate and similar non-infectious acute failure rate compared to VPS. However, percVAS patients had a better time to failure than VPS patients who had at least one prior revision. Of note, almost all percVAS were placed in patients who were inherently more complex and had failed prior VP shunts. PercVAS should be considered as a valuable option in the treatment of hydrocephalus and may be preferred in certain complex patients.

65. CEREBROSPINAL FLUID LEVELS OF APP AND NCAM-1 CORRELATE WITH VENTRICULAR SIZE IN POST-HEMORRHAGIC VENTRICULAR DILATATION

David Delmar Limbrick, MD, PhD; Diego Morales, MS; Richard Holubkov, PhD; Haejun Ahn, BS; Deanna Mercer, BS; Terrie Inder, MD, PhD (St. Louis, MO)

INTRODUCTION: Intraventricular hemorrhage (IVH) is the most common, severe complication of preterm birth and is associated with post-hemorrhagic ventricular dilatation (PHVD) in up to 50% of cases. The most devastating neurological outcomes are observed when PHVD becomes progressive and requires neurosurgical treatment. The relationship between ventriculomegaly and neurodevelopmental outcomes remains unclear.

METHODS: Cerebrospinal fluid (CSF) concentrations of APP, NCAM-1, and total protein were measured in a cohort of 12 preterm human infants with progressive PHVD who underwent implantation of ventricular reservoirs. CSF was removed as clinically indicated for decompression. CSF APP and NCAM-1 measurements were compared with ventricular size (frontal-occipital ratio, or FOR) measured on head ultrasounds performed within 24 hours of each CSF sample.

RESULTS: CSF levels of APP were strongly correlated with FOR. A modest correlation was observed between NCAM-1 and FOR, but no relationship was found between total protein and FOR. Normalizing APP and NCAM-1 levels by total protein strengthened their association with FOR. Notably, a temporal association was noted between APP and FOR, with APP levels paralleling changes in FOR over the treatment interval.

CONCLUSIONS: CSF concentrations of APP and NCAM-1 are associated with changes in ventricular size in infants with PHVD. These proteins hold promise as candidate biomarkers of PHH, potentially in combination with existing measures of ventricular size. Dysregulation of CSF APP and/or other proteins, which may occur as a result of IVH and/or axonal injury, may have implications for the neurological impairments observed in individuals affected by PHVD.

66. ERYTHROPOIETIN SIGNALING PROMOTES OLIGODENDROCYTE DEVELOPMENT AFTER PRENATAL HYPOXIC-ISCHEMIC BRAIN INJURY

Shenandoah Robinson, MD, FAANS; Lauren Jantzie, PhD (Boston, MA)

INTRODUCTION: Brain injury from preterm birth causes white matter injury (WMI) associated with chronic neurological deficits including cerebral palsy, epilepsy, and cognitive delay. Understanding how the damaged developing brain responds to injury is essential for effective therapy development, and for appropriate selection of infants to receive emerging therapies. The cytokine erythropoietin (EPO) promotes neuronal recovery after injury but its role in enhancing oligodendroglial lineage recovery after injury during development is unclear. After E18 TSHI in rats, neonatal exogenous EPO treatment enhances myelin formation and results in sustained functional recovery. Here we used in vitro assays to investigate how EPO signaling contributes to oligodendrocyte recovery in the injured developing brain.

METHODS: Transient systemic hypoxia-ischemia (TSHI) was induced on embryonic day 18 (E18) in rats. Perinatal mixed cell cultures were used to analyze stages of oligodendrocyte development with heat-inactivated EPO and neutralizing EPOR antibodies used to test specificity. Two-way ANOVA with Bonferonni's correction was used with $P<0.5$ significant.

RESULTS: EPO signaling enhances process extension of immature oligodendrocytes in a dose dependent manner($p=0.011$). After TSHI injury on E18, EPO treatment promotes multiple developmental steps including genesis of new oligodendrocyte progenitors in oligodendrogliospheres($p=0.044$), survival of oligodendrocyte precursor cells (OPC) and O4+ immature oligodendrocytes($p<0.01$), O4+ cell process extension($p<0.01$) and myelin formation($p=0.012$). EPO did not alter OPC proliferation.

CONCLUSIONS: We showed EPO signaling contributes to recovery of oligodendroglial lineage after prenatal brain injury. WMI also occurs with other types of developing brain injury such as hypoxic-ischemic encephalopathy and trauma, and EPO is likely effective in these populations too.

67. THE MANAGEMENT OF TORTICOLLIS IN INFANTS AND CHILDREN

Catherine Anne Mazzola, MD, FAANS; Lauren Schwartz, MD; Tosan Livingstone, MD; Deborah Straka-DeMarco, PT; Tara Gleeson; Kaitlyn Mulhall, RN; Stuart Wiener, CPO, LPO (Morristown, NJ)

INTRODUCTION: The incidence of torticollis and plagiocephaly in infants is high. However, there is wide variation in the approach to managing these children.

METHODS: A retrospective review of 821 patients with plagiocephaly over a seven year period from 2005 to 2012 was done utilizing a GE Centricity Electronic Medical Record database. There were 475 patients with a diagnosis of torticollis. Of the 475 with torticollis, 443 patients also had plagiocephaly. Infants with torticollis and plagiocephaly were managed conservatively with physical therapy, repositioning and cranial molding orthoses, if the parents desired. No pre-treatment cervical spine x-rays were ordered, although some infants did come to the clinic with spinal imaging studies ordered by other specialists.

RESULTS: All infants had improvement of their torticollis and plagiocephaly, except eight. These children, with persistent torticollis, despite 12 months of physical therapy, did have spine imaging studies done. All eight had findings on their spine imaging studies. Two children ultimately required surgical intervention.

CONCLUSIONS: Infants with torticollis and plagiocephaly may be conservatively followed without cervical spine x-rays. Almost all infants will benefit from physical therapy, repositioning and cranial molding orthoses, if indicated. Cervical spine x-rays done in infants, under the age of one, are often non-diagnostic. Delaying definitive imaging studies for neurologically intact infants with just torticollis is feasible, safe and effective.

68. SPINAL LEVEL OF MYELOMENINGOCELE LESION IS A CONTRIBUTING FACTOR IN POSTERIOR FOSSA VOLUME, INTRACRANIAL CEREBELLAR VOLUME AND CEREBELLAR ECTOPIA**

Kieron Sweeney; John Caird, MD; Taufiq Sattar; David Allcutt; Darach Crimmins (Donegal, Ireland)

INTRODUCTION: McLones et als theory of Chiari II Malformations(C2M) describes how the loss of CSF via the open posterior neuropore fails to create adequate distending pressure for the developing rhomboencephalic vesicle. Using a common model in biology we described how the certain features of C2M are related.

METHODS: We included all new-borns with spina bifida who were between 4 weeks premature and two months. Volumes and measurements were obtained from axial and sagittal T2 weighted MRI images of brain and spine.

RESULTS: 56 were identified. There is a direct linear relationship between PFV and CV to the spinal level of the MMC lesion ($p=0.0012$ and $p=0.0041$ respectively). There is a negative linear relationship between cerebellar descent, spinal level of lesion and PFV and CV. These relationships strengthen in those with no syringomyelia. These relationships are not significant in those with syringomyelia.

CONCLUSIONS: Using Hagen–Poiseuilles law to describe pressure in the fourth ventricle as being directly related to the length of the central canal, from the obex to the MMC lesion, we are able to explain the directly observed linear relation between PFV, intracranial CV and cerebellar descent to the level of the spinal lesion. As this model assumes a uniform radius of the central canal we are able to validate this model when we observed a strengthening in relationships in the no syringomyelia group and statistically insignificant correlations in the syringomyelia groups. Therefore we propose that the spinal level of lesion is one of the major determinants of PFV, intracranial CV and cerebellar descent.

69. ENDOSCOPIC THIRD VENTRICULOSTOMY DECREASES VENTRICULO-PERITONEAL SHUNT RATE IN POSTERIOR FOSSA TUMORS**

Shih-Shan Lang, MD; Fabio Frisoli, BS; Gregory Heuer, MD, PhD; Phillip Storm, MD (Philadelphia, PA)

INTRODUCTION: Endoscopic third ventriculostomy (ETV) has been shown to successfully manage hydrocephalus secondary to tectal region tumors. However, the effectiveness of ETV for hydrocephalus from non-tectal region tumors is uncertain. The aim of this study is to determine whether ETV is a useful alternative to ventriculo-peritoneal shunts (VPS) for posterior fossa tumors of varying histological subtypes when performed at the time of tumor resection.

METHODS: A retrospective chart review of one pediatric neurosurgeon's patients presenting with hydrocephalus from an intracranial tumor was performed. The rate of successful ETVs (patients who did not require a VPS) was assessed from 2010-2012 (ETV group). Patients who underwent tumor resection and VPS insertion by the same surgeon prior to the introduction of ETV at the institution were used as controls (2005-2010). Subgroup analyses based upon tumor location and histological subtype were evaluated.

RESULTS: Two of 20 patients (10%) required a VPS in the ETV group compared to 19 of 50 (38%) in the control group (p value = 0.0177). Patients with high-grade tumors in non-tectal and non-pineal regions had a statistically significant reduction in their VPS rate (0/7, 0% ETV group v. 11/26, 42% control group, p value = 0.039). Patients with a posterior fossa tumor also showed a lower percentage of shunt rates in the ETV group.

CONCLUSIONS: Performing an ETV at the time of tumor resection for patients with hydrocephalus greatly reduces the overall rate of VPS in all tumor locations, grades, and subtypes. Patients with high-grade tumors and posterior fossa tumors showed a significant benefit.

70. MULTICENTER IMMATURE LARGE ANIMAL BRAIN INJURY TREATMENT TRIAL: NEUROPROTECTION WITH CYCLOSPORIN A

Kristen Leigh Saliga; Susan Margulies, PhD; Todd Kilbaugh, MD; Beth Costine, PhD; Colin Smith, MD; Carter Dodge, MD; Sarah Sullivan, MS; Christopher Owen, MS; Sabrina Taylor, MS; Ann-Christine Duhaime, MD (Boston, MA)

INTRODUCTION: Many rodent models of neuroprotective agents for traumatic brain injury (TBI) have demonstrated efficacy, but none have translated to human patients. We report preliminary results of the first multicenter, immature large animal dose escalation trial of neuroprotection after TBI, using the mitochondrial protectant cyclosporin A in both focal and diffuse injury models in piglets.

METHODS: In the focal injury model arm of the study, one month old female Yorkshire piglets (n=55) underwent standardized controlled cortical impact. Subjects were randomly assigned to either vehicle or one of four dosage groups of cyclosporin A (n=10/group), and either a 1 hour (n=30) or 6 hour (n=25) delay to treatment start time. Animals were euthanized via trans-cardiac perfusion 24 hours after receiving continuous drug infusion and brains were removed for lesion quantification.

RESULTS: Treatment with 10 and 60 mg/kg/day cyclosporin A decreased injury volume compared to vehicle-treated animals in the 1 hour delay to treatment paradigm, as did the 10 mg/kg/day dose in the 6 hour delay to treatment subjects.

CONCLUSIONS: Cyclosporin A appears promising for reduction of lesion volume in the immature piglet brain after focal cortical injury. Analysis of other short-term outcome measures including mitochondrial function and serum biomarkers in both focal and diffuse injury models are ongoing, and more long-term behavioral outcomes will be tested in those doses deemed promising by initial phase testing. Immature large animal models may help bridge the gap between rodent models and clinical trials of children with different types of TBI

71. GENE EXPRESSION PATTERNS OF CNS GROWTH AND REGENERATION AT VARIOUS DEVELOPMENTAL STAGES AND AFTER INJURY**

Elias B. Rizk, MD; Krista Stewart, BS; Sivan Meethal, PhD; Nithya Hariharan, MD; Bermans Iskandar, MD (Harrisburg, PA)

INTRODUCTION: Molecular mechanisms involved in axon regeneration of injured CNS neurons may be shared with the developing CNS. Here, we study gene expression of these patterns.

METHODS: In a rat optic nerve (ON) model of regeneration, where a peripheral nerve segment is grafted to the cut edge of an (ON), approximately 1% of retinalganglion cells (RGCs) regenerate through the graft. Using a cell dissociation protocol followed by flow cytometry, regenerated RGC neurons were separated from injured neurons that did not regenerate. RGCs from rats at various embryonic and postnatal developmental stages were isolated in a similar fashion. RNA extraction and cDNA mircroarray analysis allowed a comparison of gene expression patterns of the various RGC.

RESULTS: 196 genes with higher expression in regenerating (R) versus non-regenerating(I) neurons were identified by a modified T-test (FDR < 0.05). 80 genes for which expression in R was within 1.5-fold of uninjured adult neurons (U) and 116 genes for which expression was higher in R versus U were further subdivided by hierarchical clustering. The average of biological triplicate arrays showed a subset of genes with higher expression in both regenerated as well as embryonic neurons, with a gradual rise in expression in the first 6 days of life. Heat maps were plotted to illustrate gene expression correlating to developmental stages, axonal regeneration, or both.

CONCLUSIONS: We differentiate signals associated with axon regeneration from those associated with injury alone. In addition, we present the first example of gene expression patterns that are expressed exclusively in embryonic neurons, in adult neurons with propensity to regenerate axons after injury, or both. These findings have significant clinical implications..

72. CSF COMPLICATIONS FOLLOWING INTRADURAL SPINAL SURGERIES IN CHILDREN

Victor Liu, BS; Paul Steinbok, MD, FAANS(L); Chris Gillis, MD; Doug Cochrane, MD; Ash Singhal, MD, MSC (Vancouver, Canada)

INTRODUCTION: Cerebrospinal fluid (CSF) leakage is a complication of intradural spinal surgery and is associated with poor wound healing and infection. The incidence of CSF leak is reported at 16% in adults, but little information is available in children. The purpose of this study was to determine the CSF leak rate and predisposing factors after intradural spinal surgeries in children.

METHODS: This study was a retrospective chart review of 589 patients who underwent 638 intradural spinal operations at B.C. Children's Hospital (BCCH) to identify patients who developed a post-operative CSF leak and associated risk factors. CSF leak was defined as pseudomeningocele or CSF leak through incision. Primary operations to untether lipomyelomeningoceles, myelomeningocele/meningocele closure, and Chiari decompressions were excluded.

RESULTS: CSF leaks occurred in 7.0% and were associated with a higher incidence of post-operative wound infection and meningitis (p=0.0016 and p=0.0013 respectively). The type of dural suture used, use of fibrin glue, or use of a graft did not affect CSF leak rates. CSF leaks were more frequent with simple versus locked continuous dural suturing (p=0.0023) and previous spinal surgery (p=0.0001). Patients with CSF leak were older than those without leak (98 vs 72 months, p=0.0024).

CONCLUSIONS: The results provide evidence on intraoperative factors that may predispose to CSF leaks in children with spinal intradural surgery and may help guide surgical practice. Further research is needed to explain how specific factors are associated with CSF leaks.

73. EFFECTIVENESS AND LONG TERM CLINICAL OUTCOME OF CONSERVATIVE TREATMENT FOR LUMBAR SPONDYLOLYSIS IN CHILDREN

Santoshi Shalini Indrakanti; Rory Murphy, MD; Deanna Mercer; Jeffrey Leonard, MD; David Limbrick, MD, PhD (Santa Rosa, CA)

INTRODUCTION: While lumbar spondylolysis is frequently evaluated in the pediatric neurosurgery clinic, little data exists to guide clinical management. Conservative treatment is commonly employed, but long term clinical outcomes using this strategy are poorly characterized in literature.

METHODS: Retrospective chart review from 1/1/2000 to 4/30/2012 was performed at St. Louis Children's Hospital to identify patients with symptomatic back pain and radiographic evidence of spondylolysis. Patients with spondylolisthesis greater than grade II or confounding spine pathology were excluded. Follow-up imaging was reviewed for radiographic changes (resolution, progression, stability). Where possible, telephone interviews were conducted to assess outcomes using SF-8 and ODI questionnaires.

RESULTS: Out of 456 patients, 36 patients were selected for participation based on the inclusion/exclusion criteria mentioned above. Radiographic follow-up, on average for 2.1 years, was available for 61% of the patients. Radiographic resolution of spondylolysis was observed in 21.4% while the other 78.6 remained stable. Phone interviews were conducted an average of 2.9 years following symptom onset. 77.8% of these participants continued a conservative approach while other 22.2% that were refractory underwent surgery. The ODI, SF-8 PC and SF-8 MC scores for the conservative and surgical group were 15.7% vs. 6%, 46.5 vs. 52.75 and 55. vs. 52.4 respectively.

CONCLUSIONS: While a majority of symptomatic spondylolysis patients respond favorably to conservative management, there remains a subset that fails this approach and eventually proceeds to surgery. Ongoing efforts are directed at developing methods for early identification of this subset to decrease the associated morbidity.

74. OCCIPITAL CONDYLE TO CERVICAL FIXATION IN THE PEDIATRIC POPULATION**

Libby Marie Kosnik-Infinger, MD MPH; Steven Glazier, MD; Bruce Frankel, MD; Avery Buchholz, MD, MPH (Charleston, SC)

INTRODUCTION: Occipitocervical stabilization is performed in children and adults for various conditions. The pediatric spine presents a unique challenge due to the immaturity in the osseous developmental of a child. Cadaveric studies have led to the use of occipital condyles to anchor the fixation of an occipital to cervical construct.

METHODS: Four patients, ages three to seventeen required stabilization at the craniocervical junction. The primary goal was to stabilize the spine to prevent further neurologic deterioration while simultaneously relieving compression at the craniocervical junction. There are many advantages of using occipital condyle screw fixation over occipital bone screw fixation. It allows foramen magnum decompression, it can be used if a patient had a prior posterior fossa surgery, and less hardware is present.

RESULTS: We describe four cases that required operative fixation. Pre and post-operative imaging and intraoperative details are discussed. Neuronavigation has helped to make this a safe technique to use in the pediatric spine.

CONCLUSIONS: We show that occipital condyle fixation can treat instability in this region. Due to the unique characteristics of the pediatric spine and complexity of the anatomy involved, this technique is an excellent adjunct to a surgeon's repertoire of treatment. We will investigate this concept further by reviewing pediatric radiologic studies to characterize the anatomy at the craniocervical junction and an analysis of this data will be presented. Also, as these children continue to grow, we will learn how this fixation affects their growth and development at the craniocervical junction.

75. EVALUATION OF HEMORRHAGIC COMPLICATIONS ASSOCIATED WITH PERIOPERATIVE KETOROLAC USE IN PEDIATRIC NEUROSURGERY PATIENTS

Todd Cameron Hankinson, MD, MBA; M. Richardson, MD; Nicholas Palmeri, BA; Sarah Williams; Michelle Torok, PhD; Michael Handler, MD (Aurora, CO)

INTRODUCTION: Non-steroidal anti-inflammatory drugs (NSAIDs) are highly effective for postoperative analgesia. Many neurosurgeons are reluctant to prescribe NSAIDs in the immediate post-operative period due to a perceived risk of hemorrhage. We examined the safety of an institutional practice that includes the common use of ketorolac following pediatric neurosurgical procedures.

METHODS: A retrospective analysis of 919 consecutive patients treated surgically between August, 2006 and June, 2012. Data included demographics, type of surgery, ketorolac use, potential medical confounders (ie. anticoagulant or antiplatelet therapy), and complications (ie. radiographic hemorrhage, clinically relevant bleeding events, renal failure, or gastric ulcer). Clinically relevant bleeding events were defined as those that required reoperation. Radiographic hemorrhage was assessed on axial imaging within 7 days of surgery and based on the final radiology report. Chi-square analysis and multivariable logistic regression using the backward selection approach were performed.

RESULTS: Clinically significant bleeding events occurred in 9 of 919 (0.98%) patients. Axial imaging within 7 days of surgery was completed in 371 (40.4%). Of these, 31 (8.4%) demonstrated hemorrhage. After adjusting for age, gender, medical confounders, and surgeon, statistical analysis demonstrated no significant association between clinical bleeding events (OR= 4.3, 95% CI 0.5-37.2) or bleeding detected on post-operative imaging (OR =1.4, 95% CI(0.6-3.2)) and patients receiving ketorolac compared to those who did not receive ketorolac.

CONCLUSIONS: Although the infrequency of bleeding events limits statistical power, ketorolac does not appear to be associated with a statistically significant increase in risk of clinically significant bleeding events or radiographic hemorrhage in pediatric neurosurgical patients.

76. DEFINING REASONABLE MEDICAL CERTAINTY IN CHILD ABUSE COURT CASES

Mark S. Dias, MD, FAANS; Benjamin Levi, MD; William Wenner, MD; Mark Iantosca, MD; Susan Boehmer, MS (Hershey, PA)

INTRODUCTION: Neurosurgeons testifying in child abuse cases are routinely asked if their opinions are expressed within reasonable medical certainty (RMC). However, the definition of RMC is not well defined legally and expert witnesses may use widely different thresholds for RMC when testifying. We hypothesized that there would be significant variability among medical experts.

METHODS: We surveyed physicians, including pediatric neurosurgeons, who testify as expert witnesses in child abuse court cases, to establish their definitions of RMC and the factor(s) that led to their definition. Respondents were asked to define RMC both in numerical (percentage probability), ordinal (first, second, etc. most likely diagnosis) and legal (reasonable medical certainty, preponderance of the evidence, beyond a reasonable doubt) terms.

RESULTS: We received 294 responses. The definition of RMC that abuse had occurred varied widely, ranging from ≥25% to ≥ 99%; over three quarters of respondents used a ≥ 90% threshold. Nearly half identified RMC most closely with a 'clear and convincing' standard, with one-fourth each identifying RMC more with 'preponderance of the evidence' or 'beyond a reasonable doubt' standards. There were no correlations with any demographic variable except the definition respondents had received during training.

CONCLUSIONS: There is significant variability in medical expert witnesses' definitions of RMC. The implications of this are significant and create a real potential for injustice. We call upon the legal and medical professions to either abandon the term altogether or come together to provide a consistent and universal definition of the term.

77. USE OF MRI-STIR IMAGING IN PEDIATRIC TRAUMATIC CERVICAL SPINE CLEARANCE

Steven Hwang, MD; Mark Henry; Katherine Scarlata; Amy Kalleen, BS; Alexis Chavez, BS; Ron Riesenburger, MD; James Kryzanski, MD; Leslie Rideout, RN; Amer Samdani, MD; (Boston, MA)

INTRODUCTION: Although MRI-STIR imaging has been validated in the clearance of adult cervical spine trauma, its benefit in pediatric trauma remains unclear. We sought to analyze our institution's practice patterns, assessing the use of STIR imaging to clear the cervical spine in pediatric trauma.

METHODS: We retrospectively analyzed trauma patients under the age of 18 at Tufts Medical Center, a Level 1 pediatric trauma center (2002-2011), who received cervical spine MRIs in an attempt to clear the cervical spine.

RESULTS: 134 patients (mean age = 10±5.5 yrs) were identified, of which 110 were cleared as an in-patient. Of these, 108 had negative MRIs. 2 had positive MRIs but were cleared using flexion/extension radiographs. Of those with negative MRIs, 101 were cleared solely by MRI; 7 received further studies due to physician preference. Of these 7 patients, 5 were cleared with flexion/extension films, 1 was cleared with a CT scan/clinical exam, and 1 was cleared clinically. 74 of 110 patients cleared by negative MRI had no reported symptoms on follow up appointment (mean follow up 9±18 months). 36 did not have a follow up appointment on record. Specificity for MRI-STIR imaging for cervical spine clearance was 97%.

CONCLUSIONS: MRI-STIR imaging may play a significant role in the clearance of the pediatric cervical spine in trauma as a stand-alone clearance tool. However, prospective studies are needed to evaluate and validate the impact of its usage on general patient outcomes.

78. THE IMPORTANCE OF A RADIOGRAPHIC FATTY FILUM IN THE DIAGNOSIS OF TETHERED CORD SYNDROME**

Eric Michael Thompson, MD; Michael Strong, BS; Garth Warren, MD; Nathan Selden, MD, PhD (Portland, OR)

INTRODUCTION: The purpose of this study was to correlate histologic and MRI characteristics of the filum terminale in patients with tethered cord syndrome (TCS).

METHODS: Histologic filum specimens and MRIs of patients who underwent filum transection were reviewed. MRI variables assessed included conus level and presence of a fatty or thickened (< 2mm) filum. Histological variables included presence of nerve twigs, and fibrous, vascular, adipose, and glial/ependymal tissue.

RESULTS: From 2000 to 2011, 298 patients had complete MRI and histologic data and were included in the study. The mean age was 7.0 years (range 0.1 to 64.3). Fibrous tissue was found in 94.8%, nerve twigs in 78.5%, adipose tissue in 58.8%, vascular tissue in 36%, and glial/ependymal tissue in 19.5% of specimens. Histologic features associated with a radiographic thickened filum were adipose tissue (OR 3.6, 95% CI 2-6.4, P < 0.001), nerve twigs (OR 2.2, 95% CI 1.1- 4.5, P = 0.036), and vascular tissue (OR 0.5, 95% CI 0.3-0.9, P = 0.025). Only adipose tissue (OR 2.2, 95% CI 2.4-0.9, P = 0.028) was associated with a conus level below the L2-3 disc space and with a radiographic fatty filum (OR 10, 95% CI 5.2-19.1, P < 0.001).

CONCLUSIONS: Fibrous tissue was found in nearly all specimens and likely plays a key role in the pathophysiology of TCS. Additionally, adipose tissue was significantly associated with lower lying position of the conus and a thickened filum. Hence, it may be the most important radiographic feature in the diagnosis of TCS.

79. CHIARI I MALFORMATION AND SPORTS: EVALUATING THE RISK OF INJURY**

Jennifer Mae Strahle, MD; Regina Bower, MD; Bela Selzer, NP; Hugh Garton, MD; Karin Muraszko, MD; Nicholas Wetjen, MD; Cormac Maher, MD (Ann Arbor, MI)

INTRODUCTION: Chiari I malformation (CM) may narrow CSF spaces in the upper cervical canal. It is unclear if there is an increased risk of spinal cord injury with CM in sports.

METHODS: Surveys on sport participation were administered to consecutive patients with CM seen in pediatric neurosurgery clinic at the University of Michigan or the Mayo Clinic between December 2010 and July 2012.

RESULTS: 146 patients were included in the study. Mean age at CM diagnosis was 8 years (0.5-18), mean age at time of survey was 14 years (1-32) and 53% were female. Average tonsillar herniation was 8 mm (5-30), 54 had pegged tonsils, 35 patients had a syrinx and 9 had a dilated central canal or pre-syrinx. 53 (36%) patients had a history of surgery. 61% (89) of patients participated in 28 different sports, with 54 participating in contact sports. Patients played between 1 and 6 sports. The most frequently played sports included soccer (n=29), basketball (n=23), and volleyball (n=15). The group as a whole participated in a total of 659 years of sports with an average of 7.6 years per person, and 5 months/year per sport. There was one case of transient numbness and weakness after falling while playing soccer without radiographic evidence of injury. There were no permanent injuries.

CONCLUSIONS: Participation in contact and non-contact sports does not seem to place patients with CM at increased risk of injury. Continued prospective study is needed.

80. CHIARI I MALFORMATIONS: INSTITUTIONAL EXPERIENCE OF 158 PATIENTS REVIEWING SYMPTOM RESOLUTION BASED ON OPERATIVE INTERVENTION

Renee M. Reynolds, MD; Keiko Weir; David Bauer, MD; Samuel Browd, MD, PhD; Richard Ellenbogen, MD (Seattle, WA)

INTRODUCTION: Chiari I malformations (CM1) interfere with normal CSF circulation leading to various symptoms. Consensus regarding methods of surgical intervention is lacking. This study was aimed at determining differences between operative technique, symptom resolution and complications.

METHODS: Patients undergoing surgery for CM1 at Seattle Children's Hospital between 1997-2009 were retrospectively reviewed. Bony decompressions with or without duraplasty were performed at the discretion of the surgeon. A database was established reviewing surgical intervention, pre- and post-operative symptoms, time to resolution, and complications.

RESULTS: One hundred and fifty eight patients were identified. Ages ranged from 1.14-20.19 (mean 9.94 ± 4.81) with a female:male ratio of 1.1:1. Forty-three posterior fossa bony decompressions and one hundred and twenty two additional duraplasties were performed. Symptoms with the highest percentage of postoperative resolution were occipital headaches (94.5%), neck pain (89.5%), and frontal headaches (88.3%). Except for syringomyelia, there were no statistically significant differences in symptom resolution rates or time to resolution by surgical technique. Sixty three percent of patients with syringomyelia had complete resolution although patients who underwent duraplasty were more likely to have resolution. (68% vs 20%, p = .0224). Common complications were new headaches (8.75%) and dysesthesias (3.75%) with no statistically significant difference by operative intervention. Complications exclusive to duraplasty included aseptic meningitis (4.17%), pseudomeningocele (4.17%) and CSF leak (1.85%).

CONCLUSIONS: We recommend bony decompression for patients with CM1 in the absence of syringomyelia and adequate tonsillar pulsatility on intraoperative ultrasound. All patients with syringomyelia should undergo bony decompression with duraplasty.

81. THE CASE FOR INTERNATIONAL PEDIATRIC NEUROSURGICAL EXPERIENCES: A BREAKDOWN OF US RESIDENT EXPERIENCES WITH PEDIATRIC SPINAL DYSRAPHISM CASES

Brandon G. Rocque, MD; Humphrey Okechi, MD; Kimberly Foster, MD; Luke Tomycz, MD; Jonathan Forbes, MD; Leland Albright, MD; Sandi Lam, MD (Madison, WI)

INTRODUCTION: In the National Resident Report of Neurological Surgery Case Logs prepared by the department of Applications and Data Analysis of the ACGME, the Resident Review Committee for Neurological Surgery conducted a survey of the total experience of residents completing programs in 2009-2010.

METHODS: Review of case numbers from the RRC survey and at an East African hospital with visiting US neurosurgical trainees was conducted.

RESULTS: US residents reported their experiences with the ACGME index cases categorized as "dysraphism – pediatric cases. The case experience totals across all years of residency are reported as percentiles: 20th percentile: 2 cases, 50th percentile: 7 cases, 90th percentile: 16 cases. The national resident average of pediatric spinal dysraphism cases totaled for all years was 7.9 cases. In contrast, 8 spinal dysraphism cases were reported per resident over an average 2-week rotation at Kijabe Hospital in Kenya. The pediatric neurosurgeon in residence at Kijabe has logged over 300 spinal dysraphism cases per year since summer of 2010. A 4-week international resident rotation could potentially provide experience with an average of 4 myelomeningocele cases per week. Over one month, this could eclipse the 90th percentile of US resident experience for an entire residency. This is borne out by individual experiences of residents who have visited Dr. Leland Albright in Kijabe, Kenya over the past year.

CONCLUSIONS: The role and value of international neurosurgical experiences for residency training can be significant, especially for treatment of pathologies rarely encountered in the US.

82. ISOLATION OF NEURAL STEM CELLS FROM MYELOMENINGOCELE PLACODES WITH POTENT OLIGODENDROCYTE FORMING ABILITY

Samuel H. Cheshier, MD PhD; Sharareh Gholamin, MD; Siddhartha Mitra, PhD; Chase Richard, BS; Michael Edwards, MD (Stanford, CA)

INTRODUCTION: Myelomeningocele is a congenital anomaly of spinal cord resulting from a defect in the closure of the neural tube during the forth week of embryonic development. Due to this early gestational defect in the closure of caudal neuropore, we hypothesized that tissue sample obtained could prove rich for neural stem cells and give rise to all three lineages of neural cells – neurons, astrocytes and oligodendrocytes.

METHODS: Three neural placode samples were obtained from the Lucille Packard Children's Hospital (Stanford, CA). The tissues were dissociated into a single cell suspension and plated in enriched neurobasal media with growth factors. Following neurosphere formation, cells were plated in poly-D-ornithine and laminin coated 8 chamber polystyrene tissue culture slides, where they were allowed to grow under six various differentiation conditions for two weeks prior to staining with appropriate surface markers.

RESULTS: The differentiated cells stained highly positive for oligodendrocyte markers CNPase and O4 and moderately positive for astrocyte marker S100b, and neuronal markers Tuj1, MAP2 and TBr-2. Faint GFAP staining was noted. We found Sox2 and Nestin staining in cells grown in sphere forming media.

CONCLUSIONS: Great interest exists in the potential utility of neural stem cells and progenitor cells as substrates for structural repair of the central nervous system. Our findings suggest that neural placode tissue may serve as a unique source of multipotent stem cells with potent oligodendrocyte forming ability and could prove useful in further translational studies.

83. THE DISTRIBUTION OF CEREBELLAR TONSIL HEIGHT DEFINED BY AGE: IMPLICATIONS FOR UNDERSTANDING CHIARI MALFORMATION

Cormac O. Maher, MD, FAANS; Jennifer Strahle, MD; Hugh Garton, MD; Karin Muraszko, MD; Brandon Smith, BS (Ann Arbor, MI)

INTRODUCTION: Prior attempts to define normal cerebellar tonsillar position have been limited by small numbers of subjects that have precluded analysis of normal distribution by age group. Our objective is to analyze cerebellar tonsillar position in every age group.

METHODS: 2400 subjects were randomly selected and organized into 8 age groups from a database of 62,533 consecutive subjects undergoing imaging. MRIs were directly examined for tonsil location, morphology and other features. Those with a history or imaging finding of posterior fossa abnormalities not related to CM were excluded. Measurements of caudal extent of the cerebellar tonsils were made at mid-sagittal and the lowest parasagittal position.

RESULTS: The mean tonsillar height decreased slightly with advancing age in childhood and increased with advancing age in the adult age range. Increasing age in the adult age range was associated with a decreased likelihood of tonsil position 5mm or more below the foramen magnum ($p=0.0004$) . In general, the distribution of lowest tonsil position in each age group followed a normal distribution. Patients with pegged morphology were more likely to have tonsillar location at least 5mm below the foramen magnum (85%), compared with those with intermediate (38%) and rounded (1.7%) morphology ($p<0.0001$). Female sex was associated with lower mean tonsil position ($p<0.0001$).An increasing tendency for asymmetric tonsil position, especially with a lower right tonsil, was noted with lower tonsil position ($p<0.0001$).

CONCLUSIONS: Cerebellar tonsil position follows an essentially normal distribution and varies significantly by age. This finding has implications for advancing our understanding of CM.

84. LONG TERM FOLLOW UP IN TETHERED SPINAL CORD FOLLOWING MYELOMENINGOCELE CLOSURE

Jeffrey P. Blount, MD; Christi Boddiford, BA; Betsy Hopson, BA; Chevis Shannon, PhD (Birmingham, AL)

INTRODUCTION: Limited long term follow up data is available addressing outcomes of surgical untethering of tethered spinal cord (TSC) that occurs at prior myelomeningocele (MMC) closure. We reviewed a single institution experience over a decade to study our experience with this issue.

METHODS: We identified a cohort of MMC patients (n=36) who underwent surgical untethering between 2000 and 2010 at the site of prior MMC closure. Neurologic, orthopedic and urologic outcomes post untethering were tabulated. Thirty seven to sixty month follow up was available on 24 patients.

RESULTS: Thirty six patients underwent 43 untethering procedures. Average age of presentation with TSC did not differ significantly by MMC site (thoracic 6.4+-3.1 yrs, lumbar 7.0+/-3.0 yrs, sacral 8.6 +/- 4.7 yrs). The most common signs of TSC were lower extremity weakness or gait change (n=13), scoliosis (n=11), back pain (n=6) and continence changes (n=5). Acute (<3 months) post-operative problems occurred 12 times including 5 VP shunt failures, 3 episodes of increased weakness and 2 wound issues. Acute neurologic outcomes showed arrest of decline in 4 patients, improvement in 6 patients and no neurologic change in 16 patients. Two patients showed imaging improvements with no clinical change. Long term results showed clinical stability or continued improvement in 26 patients.

CONCLUSIONS: Untethering of TSC at prior MMC site is effective at arresting neurologic decline. Long term stability of acute results is realized in the majority of patients. VP shunt failure frequently complicates untethering procedures.

E - POSTER ABSTRACTS

101. A NOVEL CRANIAL REDUCTION TECHNIQUE TO FACILITATE THE MANAGEMENT OF NEONATAL MACROCEPHALY RELATED TO HYDROCEPHALUS

Gerald Tuite, MD; Jotham Charles Manwaring, MD; Armen Deukmedjian, MD; Devon Truong; Carolyn Carey, MD; Luis Rodriguez, MD; Bruce Storrs, MD; Lisa Tetreault; (Tampa, FL)

INTRODUCTION: The management of newborns with extreme macrocephaly related to hydrocephalus can be difficult. Excessive cerebrospinal fluid drainage can result in significant suture overlap, which leads to difficulties in patient positioning, secondary synostosis, and long-term aesthetic complications. Delayed cranial reduction and remodeling procedures carry significant risk and the aesthetic outcomes have sometimes been poor.

METHODS: We describe the technical steps in a novel cranial reduction/fixation procedure through picture and video. The cases of two neonates with severe macrocephaly related to hydrocephalus are presented. Cranial reduction and fixation was performed with a large absorbable plate during the first week of life.

RESULTS: A 49% intracranial volume reduction and an immediate, marked improvement in appearance were attained in both patients. Clinical and aesthetic outcome was excellent at one year in the first patient. Four-month follow-up will be presented for the second patient.

CONCLUSIONS: This novel management strategy facilitated patient positioning, simplified hydrocephalus management, and provided an excellent aesthetic outcome. Special emphasis is placed on perioperative hydrocephalus management and operative techniques in these two cases. A brief history of cranial reduction surgery is also presented.

102. ACQUIRED CHIARI MALFORMATION FROM CYSTOPERITONEAL SHUNTING IN THE PEDIATRIC POPULATION

Neena Ishwari Marupudi, MD; John Mathieson, BS; Keshav Grover, BA; Steven Ham, DO; Sandeep Sood, MD (Detroit, MI)

INTRODUCTION: Occurrence of acquired tonsillar herniation secondary to cystoperitoneal (CP) shunting is rarely documented, although it may be a common and serious concern in patients shunted at a younger age.

METHODS: We performed a retrospective analysis of 37 pediatric patients with arachnoid cysts (ACs) who underwent insertion of a CP shunt and identified four patients who subsequently developed a Chiari I malformation (CM). We reviewed CT/MRI studies for osseous/dimensional changes of the cranial vault. We also investigated clinical manifestations, AC and shunt characteristics, and outcomes.

RESULTS: 60% of patients underwent CP shunt insertion at less than 3 years of age, primarily for supratentorial ACs. Four patients, all shunted before age three, developed a CM; the acquired CM was demonstrated between 2-5 years after shunt insertion on follow-up imaging. Three of 4 patients required revisions for shunt malfunction within one year of insertion, with two patients experiencing over-drainage symptoms. Observational analyses of imaging in patients with acquired CMs and those shunted before age 3 suggest posterior fossa (PF) overcrowding due to lack of age-appropriate cranial vault growth; PF-space-volume averaged about 18% less than age-matched controls. The prevalence of acquired CM in our patient population of shunted ACs is about 11%, and about 20% of those shunted before age 3.

CONCLUSIONS: Osseous changes in the PF and acquired CM can develop in patients with shunted ACs, particularly when shunts are placed before the age of 3. The resulting CSF hypotension at a young age, combined with venous distension, stunts osseous growth in the PF.

103. AN ALTERNATIVE HYPOTHESIS FOR ARACHNOID CYST FORMATION

Paul A. Grabb, MD (Colorado Springs, CO)

INTRODUCTION: Arachnoid cysts are considered to be lesions of developmental etiology. The traditional pathogenesis has been considered a poorly defined splitting of the arachnoid during development, and a ball-valve mechanism of CSF accumulation. We present a case that proposes an alternative or additional etiology to congenital cyst formation.

METHODS: A 13 month-old with a large middle fossa cyst presented with imaging and clinical characteristics of a typical arachnoid cyst. The clinical course and cyst evolution in this child are documented by fetal and post natal magnetic resonance imaging (MR) and computerized tomography (CT).

RESULTS: This 13 month old boy presented with temporal bone bulging and no other complaints. He was cruising. His mother had a fetal MR for abnormal fetal motion. The fetal MR displayed a hemorrhagic lesion in the right temporal lobe. Postnatal imaging displayed encephalomalacia and hemosiderin through the first six months postnatally. Other than the temporal bulge and mild esotropia his examination was normal. A CT scan displayed findings consistent with a large middle fossa arachnoid cyst. He underwent endoscopic fenestration of the cyst into the basilar cisterns. The intraoperative findings were typical for middle fossa arachnoid cysts.

CONCLUSIONS: This case documents a primary intraparenchymal hemorrhagic event occurring prenatally, that one year later resulted in a clinical presentation consistent with a typical congenital arachnoid cyst. While the historical presumed pathogenesis of arachnoid cysts may be true in some or most cases, other mechanisms such as perinatal hemorrhage may play a role in the pathogenesis of congenital cysts.

104. ANGIOCENTRIC GLIOMA, A CASE REPORT AND A LITERATURE REVIEW

Daniela Alexandru, MD; Bijan Haghighi, MD; Michael Muhonen, MD (Orange, CA)

INTRODUCTION: Angiocentric gloma, pediatric brain tumor, has been recognized only since 2007 WHO Classification of Tumors of the CNS.

METHODS: A twelve year old child presented with intractable seizures and a lesion in the temporal lobe, hyperintense on T2 and FLAIR magnetic resonance images and not enhancing with contrast. Gross total resection was performed and the patient had complete seizure control. Histologicaly the lesion was composed of monomorphous cells arranged in a perivascular pattern, with variable immunoreactivity to GFAP. To establish prognosis and treatment, a literature review was performed and 28 patients with angiocentric glioma were identified.

RESULTS: Of these, 96% presented with intractable seizures and only three patients had different symptoms, one had decreased vision and headaches, another had otalgia and the third was ataxic. In 27 patients the tumors were in supratentorial location. The age at surgery ranged from 2 to 14 years, suggesting that this is a primarily pediatric brain tumor. Sixteen of the twenty nine patients underwent gross total resection with complete seizure control. Of the nine patients who had subtotal resection, four had seizure recurrence. The brainstem angiocentric glioma patient had biopsy, followed by radiation therapy. At two year follow up the patient was seizure free, and the tumor has not increased in size.

CONCLUSIONS: Angiocentric glioma presents most often with seizures, gross total resection is curative and no radiation or chemotherapy is needed in cases where gross total resection was achieved. For unresectable tumors, the addition of radiation therapy helps control seizures and tumor progression.

105. APLASIA CUTIS CONGENITA AND TRIGONOCEPHALY: A VARIATION OF CRANIOECTODERMAL DYSPLASIA

Alexandre Casagrande Canheu, MD; Luiz Gustavo de Souza, MS; Sergio Georgeto, MD; Marcos Dias, MD; Fahd Haddad, MD (Cianorte, Brazil)

INTRODUCTION: Cranioectodermal dysplasia, as known as Sensenbrenner syndrome, is a rare and heterogeneous condition hard to deal with in our daily practice. This case presents a conservative neurosurgical approach of this disease. Case Report: A 15 months girl with a past history of premature delivery harboring aplasia cutis congenital already healed, chronic anemia, gastro esophageal reflux, craniosynostosis named as trigonocephaly, generalized seizures, motor delay, congenital heart disease named as interatrial communication, thin hair, low weight and height. She has an uncle who was born with aplasia cutis congenital as well.

METHODS: Patient has been followed up for 2 years as a conservative neurosurgical approach whereas she was submitted to a cardiac operation and has been doing well since it, recovering partially the weight and height. The chronic anemia did not recover enough. The parents were not confident to accept neurosurgical repair considering the aesthetical appearance was satisfactory.

RESULTS: The girl has been consulted every three months presenting a slight frontal keen with slow albeit progressive neurological improvement. Nowadays she is three and a half year-old and she can stand and walk with a little help, although with poor language status. The seizures have been ceased with proper treatment. We still hold the wait and see decision once the parents are satisfied with her face.

CONCLUSIONS: There are a myriad of patterns encasing the cranioectodermal dysplasia, and we must analyze each case separately knowing that in many cases the lesser we do is the better to do.

106. ARACHNOID CYSTS AND UNDIAGNOSED IDIOPATHIC INTRACRANIAL HYPERTENSION

Rachana Tyagi, MD; Kevin Anton, BS; Jan Wollack, MD (New Brunswick, NJ)

INTRODUCTION: Idiopathic intracranial hypertension (IIH) is a condition caused by chronic elevation of intracranial pressure in the absence of intracranial mass, obstructive hydrocephalus, or other known etiology producing neurological sequelae such as headache, nausea, vomiting, and papilledema. Similar symptoms related to increased intracranial pressure are seen in the presence of arachnoid cysts.

METHODS: We report 2 pediatric patients with IIH who presented with arachnoid cysts.

RESULTS: Both patients were surgically treated with cyst fenestration with recurrent development of pseudomeningoceles post-operatively. Both were eventually diagnosed with idiopathic intracranial hypertension and successfully treated medically.

CONCLUSIONS: These cases suggest an association between arachnoid cysts and IIH, which may be useful in providing a more timely diagnosis, providing appropriate treatment and avoiding unnecessary surgery.

107. ARNOLD CHIARI TYPE 1 MALFORMATION PRESENTING WITH SLEEP DISORDERED BREATHING IN WELL CHILDREN

Elias B. Rizk, MD; Shane Tubbs, PhD; Jerry Oakes, MD; Curtis Rozzelle, MD; James Johnston, MD; Jeffrey Blount, MD; John Wellons, MD, MSC (Harrisburg, PA)

INTRODUCTION: The Chiari type 1 malformation is a congenital brain stem abnormality characterized by caudal herniation of the cerebellar tonsils through the foramen magnum resulting in crowding at the cranio-cervical junction.

METHODS: 3 patients presented with severe central apnea and severe compression of the foramen segment with magnetic resonance imaging confirming the diagnosis of Chiari 1.

RESULTS: 3 patients underwent urgent surgical treatment with a posterior fossa decompression for marked central sleep apnea at the Children's Hospital of Alabama between 1993-2012. A chart review was performed to determine the natural history of the central sleep apnea and the time to reversal of symptoms following surgical decompression.

CONCLUSIONS: Based on our experience, urgent surgical decompression is recommended in cases of Chiari type 1 malformation with significant brain stem compression and central sleep apnea with no other etiology.

108. ASYMPTOMATIC SYRINGOMYELIA WITH SCOLIOSIS IN A SIBLING GROUP WITHOUT CHIARI I MALFORMATIONS

Catherine Mazzola, MD; Benjamin Horowitz; Mark Rieger, MD (Teaneck, NJ)

INTRODUCTION: The clinical management of children with asymptomatic syringomyelia is challenging. Scoliosis and Chiari I malformation are present in many children with syringomyelia, and these co-morbidities are frequently found in asymptomatic patients. The diagnoses of syringomyelia and scoliosis in a sibling group without Chiari I malformations have rarely been reported. Here we present an unusual case report of two siblings who were diagnosed with dextro-scoliosis and syringomyelia, without Chiari I malformations and without significant neurological deficits.

METHODS: Each patient underwent serial spinal magnetic resonance imaging (MRI) scans which revealed similar syrinxes, 4-7mm in diameter, between T-5 and T-12. Both siblings began wearing a night-time Providence brace after the right thoracic curve progressed to approximately 26 degrees. Patients were folowed neurologically and orthpedically.

RESULTS: Since application of the Providence spinal orthosis, their curves have reduced to about 15 degrees when measured without the brace. The syrinxes have not enlarged over two and a half years. Both patients continue conservative orthopedic and neurosurgical treatments, following the syrinxes with annual MRI scans and the scoliotic curves with radiographs.

CONCLUSIONS: While previous studies have revealed genetic links to idiopathic scoliosis and to Chiari I malformation with or without secondary syringomyelia, this case supports the possibility of a unique genetic link to syringomyelia with secondary scoliosis and without Chiari I. This report should encourage further documentation of family members with syringomyelia, close monitoring of patient's immediate relatives, and further research into the genetic basis of syringomyelia.

109. CEREBRAL VOLUMES AND DEVELOPMENTAL OUTCOMES IN PRETERM INFANTS WITH INTRAVENTRICULAR HEMORRHAGE

Timothy W. Vogel, MD; Hassan Akbari, BA; Peter Anderson, PhD; Meredith Estep, PhD; Yuning Zhang, MS; Dimitrios Alexopoulos, MS; Lex Doyle, MD; Diego Morales, MS; Terrie Inder, MD; David Limbrick, MD, PhD (St. Louis, MO)

INTRODUCTION: Intraventricular hemorrhage-(IVH) is a common and severe neurological complication arising from preterm birth, occurring in 15-20% of infants. While infants with IVH suffer significant developmental impairments, the relationship between region-specific cerebral volumes and developmental outcomes in the affected children remains unclear.

METHODS: We performed a retrospective case-control analysis of preterm infants receiving MRI at term equivalent-(TE) age. Infants were separated into three groups based on their IVH scores-(no IVH, Grade I or II IVH, and Grade III/IV IVH). Cases were matched based on gender, gestational age, and clinical risk index for babies-(CRIB) scores. Brain volumes were generated for CSF, cortical grey matter, myelinated white matter, and unmyelinated white matter. Brain regions were also further subdivided into 8 additional anatomic regions based on known functional status. Developmental outcomes were calculated at 2 years of age using Bayley Scales of Infant Development II-(BSID-II), and at 7 years of age using the Movement Assessment Battery for Children-(MABC2). Outcome measures were compared between the three groups using analysis of covariates-(ANCOVA).

RESULTS: High grade IVH-(grade III/IV) affects cerebral morphology, causing significantly larger relative orbitofrontal volume and CSF volume determined by TE MRI scans-($p<.05$). High grade IVH results in significantly smaller premotor basal ganglia, sensorimotor myelinated white matter, and relative inferior occipital and cerebellar unmyelinated white matter in preterm infants-($p<0.03$). Cognitive and motor functioning were lower with high grade IVH.

CONCLUSIONS: The observed trend of decreasing cognitive and motor function with increasing IVH grade may be associated with changes in regional volumes and ventricular size secondary to IVH.

110. CHANGING GLOBAL TRENDS IN SEIZURE OUTCOMES FOLLOWING RESECTIVE SURGERY FOR TUBEROUS SCLEROSIS IN CHILDREN WITH INTRACTABLE EPILEPSY

George M. Ibrahim, MD; Aria Fallah, MD; James Rutka, MD, PhD (Toronto, Canada)

INTRODUCTION: Tuberous sclerosis (TS) is the leading cause of genetic epilepsy worldwide. Resective surgical strategies, which may mitigate the disease burden by securing relief from seizures, have evolved considerably over time. Here, we evaluate changes in seizure outcomes following resective epilepsy surgery in children with TS over the last 50 years.

METHODS: A systematic review of literature was performed to identify studies reporting seizure outcomes following resective epilepsy surgery in children with TS. Using an individual participant meta-analysis approach, seizure outcomes and associated covariates were combined from selected articles. Favorable seizure outcome was defined as Engel Class I-II. Multivariate logistic regression was used to determine significant associations between seizure outcomes and time of surgery.

RESULTS: Twenty studies from 1966 to present, yielding 186 participants met inclusion criteria for the study. On multivariate analysis, adjusting for length of follow-up, a trend towards improved seizure outcomes following resective epilepsy surgery for TS was observed (Odds Ratio [OR] 0.52; 95% Confidence Interval [CI] 0.23-1.17; $p=0.11$). In the last 15 years, a greater proportion of younger children also underwent resective surgery compared to prior (OR 0.93; 95% CI 0.89-0.97; $p<0.01$). There were no significant differences between outcomes in North America and elsewhere ($p=0.45$).

CONCLUSIONS: A non-significant trend towards improved seizure outcomes following resective surgery for TS was observed from 1966 to present.

111. CHIARI I MALFORMATION: OUTCOME, COMPLICATIONS AND PERIOPERATIVE MANAGEMENT

Subash Lohani, MD; Marie Lightowler; R. Michael Scott, MD; Liliana Goumnerova, MD (Boston, MA)

INTRODUCTION: Chiari I malformation is a common condition requiring surgical management when clinically indicated. The perioperative management may include pre-operative and post-operative laboratory evaluations, blood availability and overnight stay in an ICU or acute care unit. We reviewed our experience with all surgical procedures for Chiari I malformations with specific attention to complications related to surgery, length of stay and need for detailed pre-operative evaluation to provide guidelines for peri-operative management.

METHODS: Retrospective review of all patients with surgical decompression for Chiari I malformation was performed over the past 5 years. Financial data from the hospital was obtained with respect to the cost associated with laboratory investigations and post-operative hospital stay.

RESULTS: There were a total of 272 patients. There was no significant abnormality in routine pre-operative lab studies. Blood loss was 45.5 mL in average with one instance of 400 mL blood loss needing RBC transfusion. Post-operatively all but nine were managed on the floor. Average duration of post-operative dexamethasone use was 4.3 days. Average length of hospital stay was 3.5 days. There were 9 complications. One patient developed hydrocephalus requiring shunting.

CONCLUSIONS: Surgical decompression for Chiari I malformation has a low rate of post-operative complications and is effective in alleviating the associated clinical symptoms. Routine blood work is not indicated and post-operative management in most cases does not require admission to an ICU or acute care unit.

112. CHIARI TYPE 1 MALFORMATION AND SYRINGOMYELIA: RISK FACTORS FOR DEVELOPMENT OF SPINAL DEFORMITY

Jakub Godzik; David Kim, BA; Michael Kelly, MD; Jeffrey Leonard, MD; Matthew Smyth, MD; TS Park, MD; David Limbrick, MD (St. Louis, MO)

INTRODUCTION: The association of spinal deformity and syringomyelia in children with Chiari Type I Malformation (CIM) is well described, but the nature of this relationship remains unclear. In the current study, we sought to quantitate the relationship between syrinx size and spinal deformity in this population.

METHODS: Medical records from a single institution were queried for individuals ≤18 years with CIM-associated syringomyelia (2001-2011). Subjects with spine deformity were identified using standard criteria on radiograph, CT, or MRI. Univariate and stepwise multivariate logistic regression analyses were utilized to assess the relationship.

RESULTS: Ninety-four subjects with CIM and syringomyelia were identified in the study interval. A total of 41 (44%) patients were found to have spine deformity, 23 (56%) of which carried a previous diagnosis of deformity, and 18 (44%) were diagnosed during workup for their presenting symptoms. Multivariate regression analysis identified syrinx width (OR 1.388, CI95% 1.151-1.673, $p = 0.001$) and tonsillar herniation (OR 0.875, CI95% 0.767- 0.997, $p = 0.044$) as significantly associated with diagnosis of spine deformity when controlling for age, gender, and syrinx location. ROC analysis demonstrated 82.5% sensitivity and 60% specificity for presence of spinal deformity with syrinx width greater than or equal to 5mm.

CONCLUSIONS: The results from this study demonstrate a positive association between syrinx characteristics and the presence of spinal deformity in patients with CIM. The predictive value of imaging parameters may offer guidance in management of patients at higher risk of spinal deformity and foster improved communication between orthopedic and neurosurgical health providers.

113. COMPLICATION AVOIDANCE DURING RESECTION OF FOURTH VENTRICULAR BRAIN TUMORS WITH BRAIN STEM INVASION: VALUE OF INTRA-OPERATIVE EMG MAPPING OF FACIAL COLLICULUS IN PRESERVATION OF FACIAL NERVE FUNCTION IN PEDIATRIC PATIENTS

Samer K. Elbabaa, MD, FAANS (St. Louis, MO)

INTRODUCTION: Microsurgical approaches to the rhomboid fossa for resection of fourth ventricular tumors carry risks of lower cranial neuropathies including permanent facial palsy, especially in cases of brainstem invasion. Multiple reports looked at EMG mapping of facial colliculus and safe entry zones into intrinsic brainstem tumors. We review our experience and facial nerve functional outcomes with pediatric fourth ventricular tumors with brainstem invasion.

METHODS: Retrospective review of operative notes, MRI images and documented pre- and post-operative facial nerve functional outcomes in pediatric patients who underwent EMG facial response mapping during microsurgical resection of fourth ventricular tumors with brainstem invasion.

RESULTS: Six children were identified. Age range (2-16 years), average age 9.1 years. There were 3 medulloblastomas (2 classic,1 anaplastic) and 3 pilocytic astocytomas(JPA).All tumors were confirmed to be invading the brainstem on intraoperative gross findings or on preoperative MRI imaging. After resection of fourth ventricular component of the tumor; EMG mapping of facial colliculus on each side was performed using direct stimulation followed by resection of brainstem component according to EMG findings. Average follow-up was 6 months. Post-operative MRI imaging revealed gross total resection in 5 patients and near total resection in 1 patient with JPA. Average pre-operative House-Brackmann (HB) score of facial nerve function was 1.5 (range 1-3) and average post-operative score was 1.5 (range 1-4). All patients had improved or stable HB score, except 1 patient.

CONCLUSIONS: In our small series, brainstem EMG mapping of facial colliculus proves to be a valuable tool in preserving facial nerve function in pediatric patients with fourth ventricular tumors with brainstem invasion.

114. COMPLICATIONS OF PEDIATRIC CRANIOPLASTY: A SYSTEMATIC REVIEW

Kaushik Amancherla, BS; Brandon G. Rocque, MD, MS; Sandi Lam, MD (Madison, WI)

INTRODUCTION: Cranioplasty following decompressive craniectomy is routinely performed in both adult and pediatric populations. Evidence in the adult population suggests that this procedure is associated with higher rates of complications than elective cranial surgery. This study is a review of the literature assessing factors that affect the risk of complication after cranioplasty surgery in pediatric patients.

METHODS: A systematic search of PubMed, Cochrane, and SCOPUS databases was undertaken. Studies assessing timing of surgery, bone flap storage method, time to reimplantation, material used, or complication rates were selected for further analysis.

RESULTS: Articles were screened based on title and abstract. Out of 20 studies investigating the incidence of cranioplasty complications, 9 focused on a pediatric population and were included in this analysis. The incidence of bone resorption following cranioplasty was reported in seven studies and ranged from 7.4% to 50%. The incidence of post-operative infection ranged from 6.56%-21.4%, as reported in three articles. Considering the limited number of articles and the small sample sizes involved, there is insufficient data to draw any meaningful conclusions regarding risk factors that predispose pediatric patients undergoing cranioplasty to bone resorption or infection.

CONCLUSIONS: There is a paucity of studies assessing outcomes and complications following cranioplasty in children and adolescents. There is little evidence to suggest that method of flap preservation, timing of surgery, material used, or time to reimplantation has an influence on the incidence of complications. Larger studies, both prospective and retrospective, are urgently needed in order to shed more light on this important issue.

115. CONGENITAL DERMAL SINUS WITH AN INFECTED DERMOID CYST IN CERVICO-THORACIC SPINAL CORD

Brian Lee, MD; Yasser Jeelani, MD; J. Gordon McComb, MD (Los Angeles, CA)

INTRODUCTION: Congenital dermal sinuses (CDS) are epithelium-lined tracts that result from incomplete separation of cutaneous ectoderm from the underlying neuroectoderm. CDS may be associated with dermoid cysts and can cause complications by mass effect & by functioning as a pathway for infection. Cervical and thoracic tracts are rare, making up 1% and 10% of all CDS.

METHODS: We present an unusual case of a cervico-thoracic CDS with concomitant infected dermoid leading to neurological dysfunction.

RESULTS: A one-year-old male with a normal developmental history presented with a several week history of progressive weakness. Previous visits to two outside emergency departments diagnosed the patient with acute otitis media for which he had two courses of antibiotics with no improvement in symptoms. After another episode of fever and worsening of neurological symptoms, the patient was correctly diagnosed as having CDS with an infected dermoid cyst. Antiobiotics were initiated, the lesion was resected and the patient improved neurologically.

CONCLUSIONS: Although cervical and thoracic CDS with infected dermoids are rare, one should have a high index of suspicion when cutaneous stigmata of spinal dysraphism are identified. Due to the risk of neurological deterioration, the recommended treatment of CDS with or without a concomitant intraspinal dermoid is prompt administration of antibiotics and definitive surgical intervention.

116. CONGENITAL OS ODONTOIDEUM ARISING FROM THE SECONDARY OSSIFICATION CENTER WITHOUT PRIOR FRACTURE

Brian Jeffrey McHugh, MD; Ryan Grant, MD; Michael Diluna, MD (New Haven, CT)

INTRODUCTION: The etiology of os odontoideum has been debated in the literature since it was initially described. Here we present a case of os odontoideum, review the literature, and propose that the etiology of os odontoideum is multifactorial and related to the embryology and vascular supply to the odontoid process.

METHODS: We present the case of a four-year old female with os odontoideum and atlantoaxial instability after a motor vehicle collision and conduct a comprehensive review of the available literature focusing on the evidence supporting congenital versus traumatic etiology.

RESULTS: Flexion-extension views demonstrated atlantoaxial instability with an atlantodental interval (ADI) of 15 mm on flexion. CT scan shows a well-corticated bony ossicle consistent with os odontoideum and MRI shows no acute bony or ligamentous injury and a normal spinal cord. CT imaging performed three years earlier demonstrated an incompletely ossified, cartilaginous, orthotopic os separated from the body of the odontoid process at the level of the secondary ossification center with a short odontoid process. This case presents the earliest imaging demonstrating the presence of a congenital orthotopic os odontoideum at the secondary ossification center. However, available literature supports both congenital and traumatic etiologies.

CONCLUSIONS: Most descriptions os odontoideum pre-date the modern era for radiographic work-up of craniocervical pathology. We describe a congenital os odontoideum with craniocervical instability, without CT evidence of an initial fracture at presentation, three years prior. We support a multifactorial etiology of os odontoideum and propose that the dens requires a balance between embryologic segmental development, anatomic alignment, and blood perfusion.

117. CONSERVATIVE MANAGEMENT OF CHIARI MALFORMATION IN CHILDHOOD TRANSVERSE MYELITIS

Sudhakar Vadivelu, DO; Daniel Becker, MD; Akash Patel, MD; Sabih Effendi, MD; Sohum Desai, MD; Andrew Jea, MD; William Whitehead, MD; Thomas Luerssen, MD; Robert Dauser, MD (Houston, TX)

INTRODUCTION: Abrupt onset of myelopathy involving ascending bilateral motor and sensory nerve distributions with autonomic dysfunction can be seen following recent community acquired infection in transverse myelitis. Few cases may present with incidental chiari malformation. No previous reports have identified this association. We describe the association of tonsillar ectopia and transverse myelitis, management patterns and illustrate select cases where regression of the acquired chiari malformation occurred.

METHODS: Between the years of 2006 - 2012, we retrospectively reviewed a two center experience with childhood cases of transverse myelitis referred with chiari malformation. A total of nine patients were identified and demographic, anatomical, and outcome characteristics were examined.

RESULTS: During the 6 -year period, children presenting with transverse myelitis and noted to have chiari malformation ranged in age from 9 mos to 7 years of age and presented with a documented history of recent community acquired infection. Radiographic evidence of spinal cord edema in all cases appeared in the cervical spine, with few cases extending to the thoracic spine and without T1 indices consistent with cystic cavitation. In all cases, the acquired chiari malformation was treated conservatively. In two cases, we observed regression of ectopia and in none of the cases was there progression towards cranial neuropathies, hydrocephalus or syrinx formation.

CONCLUSIONS: Transverse myelitis can be associated with acquired Chiari anomalies in select cases. Asymptomatic chiari malformations can be managed conservatively, and in few cases observed with regression after steroid treatment for transverse myelitis.

118. CRANIOCEREBRAL DISPROPORTION (CCD) AS A COMPLICATION OF SHUNTED HYDROCEPHALUS: A SERIES OF TWO PATIENTS AND PROPOSAL FOR A RATIONAL DEFINITION, DIAGNOSIS, AND TREATMENT PROTOCOL

Adam Lance Sandler, MD; Lawrence Daniels, MD; David Staffenberg, MD; Eliezer Kolatch, BA; James Goodrich, MD, PhD; Rick Abbott, MD (Bronx, NY)

INTRODUCTION: The shunted child who suffers from chronic, debilitating headaches despite a functioning shunt represents a diagnostic and therapeutic challenge. The notion that a subset of such children may be suffering from a mismatch between the fixed intracranial volume and the growing brain has been offered as one explanation for these problematic headaches since the mid 1970s. The lack of a reliable, reproducible method to diagnose this condition, however, has hampered attempts to treat it appropriately. Furthermore, for those practitioners who believe that the fundamental problem with these patients is not an incongruency between CSF production and absorption but rather a discrepancy between the volume of the intracranial contents and the available intracranial space, the lack of agreed-upon therapeutic endpoints for cranial vault expansion techniques has limited the use of such techniques in treating this entity.

METHODS: Here the authors present a concise definition of craniocerebral disproportion (CCD), based primarily on the temporal correlation of plateau waves on Intracranial pressure (ICP) monitoring with headache exacerbation, and secondarily, on various radiographic signs. A technique of exploiting continued ICP monitoring during progressive cranial expansion is described whereby the goal of expansion is defined as the cessation of plateau waves.

RESULTS: Two recent cases in which this protocol was employed successfully are presented.

CONCLUSIONS: The evidence for CCD–; anatomic, pathologic, histologic, radiographic–; is robust and can no longer be seriously denied. Problems of under-expansion encountered previously may be resolved through the simultaneous utilization of ICP monitors and REDII rigid external cranial vault distractors.

119. WITHDRAWN

120. DECOMPRESSIVE HEMICRANIECTOMY FOR ISCHEMIC STROKE IN THE PEDIATRIC POPULATION

Sacit Bulent Omay, MD; Michael Fu; Grant Ryan, MD; Michael Diluna, MD; Charles Duncan, MD; Ketan Bulsara, MD (New Haven, CT)

INTRODUCTION: Decompressive hemicraniectomy (DH) is now increasingly considered as beneficial therapy for stroke patients with unilateral hemispheric edema after failed conservative management in the adult population. No major study has yet addressed this topic in pediatric population.

METHODS: A literature review of pediatric DH for stroke was performed.

RESULTS: In total, 11 patients were reported. All had satisfactory outcomes except one who had a dominant hemisphere infarction. Two other children with dominant hemisphere infarctions have no residual language deficit.

CONCLUSIONS: Our observations in reviewing these cases suggest that a DH can be of benefit inhemispheric stroke in children after failure of maximal medical management. DH should be part of the armamentarium in treating patients who have failed maximal medical management. Properly designed prospective studies in the pediatric population are needed to determine optimal timing and predictors for best outcome.

121. DEVELOPMENT OF NQF MEASURE OF SHUNT MALFUNCTION

Sarah C. Jernigan, MD; Liliana Goumnerova, MD; Jay Berry, MD, MPH; Dionne Graham, PhD (Boston, MA)

INTRODUCTION: Shunted hydrocephalus has significant long-term morbidity and costs associated with its complications. Boston Children's Hospital submitted a measure of shunt malfunction rate to NQF that can be applied universally based on administrative data.

METHODS: We tested the ICD9 coding algorithm for shunt malfunction against actual shunt malfunction as determined by medical record review within two children's hospitals which participate in the PHIS database. All shunt procedures at BCH were reviewed and the algorithm was validated at Texas Children's Hospital. The sensitivity, specificity, predicted positive value (PPV), and predicted negative value (PNV) were calculated overall and within each institution. Our primary outcome was VP shunt revision within 30 days of initial placement. SAS was used for statistical analysis.

RESULTS: Among the 106 charts reviewed at the two institutions, the ICD9 coding algorithm correctly identified 9 of the 12 malfunctions found by chart review resulting in a sensitivity of 0.75. The coding algorithm had high specificity (0.96) and a low false negative rate (3%). Performance of the coding algorithm was better at CHB than TCH; however the differences did not reach statistical significance, perhaps due to small sample sizes.

CONCLUSIONS: Our results demonstrate that ICD9-coded administrative databases, such as the PHIS dataset, can be used to evaluate VP shunt malfunction with acceptable sensitivity and high specificity. The high specificity of the algorithm provides the desirable property of guarding against over-estimation of the VP shunt malfunction rate. This is the first nationally accepted pediatric neurosurgery quality outcome measure.

122. DIAGNOSTIC ERRORS IN CRANIOSYNOSTOSIS

Alexandre Casagrande Canheu, MD; Sergio Georgeto, MD; Marcos Dias, MD; Marcio Lehmann, MD; Carlos Zicarelli, MD; Fahd Haddad, MD (Cianorte, Brazil)

INTRODUCTION: Craniosynostosis is a common issue at pediatric neurosurgical daily practice. However general neurosurgeons also deal possibly with these infants. Thus, diagnostic errors in craniosynostosis play an important role that must be discussed.

METHODS: Case 1: A 8 months boy, whose parents and pediatrician both agreed about frontal elongation. The case was conducted by a general neurosurgeon who diagnosed trigonocephaly, scheduled the surgery and noticed the pediatric neurosurgeon. Later on the pediatric neurosurgeon realized was not a really craniosynostosis, and the surgery was ruled out. The metopic suture was opened with a slight closure at the basis, expected at this span of life. Case 2: A 6 months boy, presenting a mild frontal elongation, with no keen visible. The boy was referred to the pediatric neurosurgeon believed to be about surgical approach. Images showed complete closure of the metopic suture with no signal of frontal keen beside small foci of bilateral thin parietal bone suggesting some mesenchymal disturbance. No surgery was performed once there is no real craniosynostosis.

RESULTS: The neurosurgeon must be aware and rise up suspicion whenever the clinical picture or exams don't show the classical features expected in those cases. So the pediatric neurosurgeon should be consulted every since one is dealing with craniosynostosis. Both children discussed above had been operated on if there wasn't a pediatric neurosurgeon.

CONCLUSIONS: Especially in developing countries is not so easy to find pediatric neurosurgeons. The neurosurgical teaching must continue to grow in order to avoid diagnostic errors and reckless.

123. DIAGNOSTIC MINI-ENDOSCOPIC VISUALIZATION: AN ADJUNCT IN DETERMINING THE NEED FOR OPERATIVE CHIARI RE-EXPLORATION

David M. Frim, MD, PhD, FAANS, FACS (Chicago, IL)

INTRODUCTION: In a minority of operated Chiari patients, symptoms do not resolve postoperatively. Re-evaluation with MRI to assess for adequate subarachnoid space, with MRI CINE flow to assess 4th ventricular outflow, and with lumbar puncture to assess CSF pressure, are sometimes unrevealing. We describe an endoscopic technique that can determine the need for open re-operation in this situation.

METHODS: Technique: Patients are positioned prone with head flexion in pin fixation. A 5 - 8 mm incision is made over the recapitulated cisterna magna space and dissected towards the 4th ventricle. A 16g angiocatheter is then placed into the CSF space followed by a 1.2 mm diagnostic endoscope. Direct visualization of 4th ventricular outflow is made and if impeded, the surgery can be expeditiously converted to open exploration and re-decompression.

RESULTS: This technique has been applied 6 times. In 3 cases the endoscopy led to open surgery revealing 4th ventricular outflow obstruction; re-decompression resolved the recurrent symptoms. In the negative explorations, patients were ready for discharge the following morning and referred for non-surgical treatments.

CONCLUSIONS: The decision to perform re-operative Chiari surgery is a complicated one. We describe a minimally invasive endoscopic approach that allows direct visualization of previous decompressions when other testing is unrevealing and the clinical situation compelling. Applying this technique demonstrates that despite negative evaluations there are patients that will benefit from re-decompression. This technique can also determine when open re-exploration is not needed.

124. DIFFUSION TENSOR IMAGING TRACTOGRAPHY AND FRACTIONAL ANISOTROPY IN PEDIATRIC SPINAL CORD PATHOLOGY

Brian Joseph Kelley, MD; Helmuth Gahbauer, MD; Michael Diluna, MD; Charles Duncan, MD; Keith Heberlein, PhD; Gordon Sze, MD (New Haven, CT)

INTRODUCTION: Diffusion tensor imaging (DTI) is an extension of magnetic resonance allowing for tractography. Fractional anisotropy (FA) measures the molecular motion of water and is quantified between 0 (isotropic) and 1 (anisotropic). DTI assists with pre-operative planning, most often for intracranial lesion resection while FA serves as a relative indicator of tract health, with values closer to 1 suggesting intact myelin. While these modalities have been widely utilized within adult populations, extension to pediatric patients has been less forthcoming especially within the context of spinal cord pathology.

METHODS: Patients undergoing spinal MRI received additional DTI sequences from which tractography and FA values were generated. Post-operative T1 / T2 images, tractography, and FA values within the cervical region of a 10 year-old patient who presented with Chiari I malformation and syrinx were reviewed. T1 / T2 images were used to localize the syrinx and superimposed upon DTI sequences to assist with FA measurements.

RESULTS: Tractography revealed linear tracts around the syrinx. FA values above and below the syrinx served as internal controls for intact cord while diminished values within the syrinx confirm pathology. Areas immediately adjacent to the syrinx also demonstrated diminished FA values despite conventional T1 / T2 morphology suggesting pathology not appreciated by standard imaging.

CONCLUSIONS: Tractography and FA values may be used to evaluate pediatric spinal cord pathology. Serial imaging protocols utilizing DTI will generate longitudinal data that compares FA values and may help direct operative treatment for evolving lesions such as syringomyelia, intramedullary tumors, and spinal cord injury.

125. DOES HELMET USE PLAY A ROLE IN THE PATTERNS OF HEAD INJURIES IN PEDIATRIC DOWNHILL SKIIERS AND SNOWBOARDERS?

Christina Mieko Sayama, MD; John Kestle, MD, MSC (Salt Lake City, UT)

INTRODUCTION: Downhill-skiing and snowboarding-related head injury, helmet use, and pattern of head injury have been studied in adults but similar studies are lacking in children. We hypothesize that the pattern of head injury differs for helmeted versus non-helmeted children admitted to the hospital after a skiing- or snowboarding-related accident.

METHODS: We reviewed the prospectively-collected trauma database of all children admitted to Primary Children's Medical Center with diagnosis of traumatic brain injury after a skiing/snowboarding-related injury between January 2002 and December 2011. Helmet use was recorded and radiographic imaging (CT or MRI) reviewed for each patient to determine the pattern of head injury (SDH, EDH, SAH, contusion, skull fracture, pneumocephalus, or negative).

RESULTS: There were 201 patients in our cohort, 11 were excluded because helmet use was not recorded. Of the 101 patients wearing helmets; two were noted to have skull fractures (2%), 11 had SAH/contusions (10.9%), and four had an EDH/SDH(3.9%). Of the 89 children not wearing helmets; 10 had skull fractures (11.2%), 7 had SAH/contusion (7.8%), and 5 had an EDH/SDH (5.6%). We found that those wearing a helmet were 5.7 times (95% CI 1.54 -; 20.83) less likely to have a skull fracture than those not wearing a helmet. The incidence of traumatic SAH/contusion, SDH, and EDH were otherwise similar in both groups.

CONCLUSIONS: Helmet use significantly decreased the incidence of skull fracture in children seen in the hospital after a skiing or snowboarding-related accident, however there was no difference in the patterns of head bleed.

126. DOES RADIOTHERAPY-INDUCED REDUCTION IN TUMOR VOLUME TRANSLATE INTO LONGER SURVIVAL FOR CHILDREN WITH DIFFUSE INTRINSIC PONTINE GLIOMAS?

Yasser Jeelani, MD; Stefan Bluml, PhD; Brian Lee, MD, PhD; Joffre Olaya, MD; Mark Krieger, MD; J. Gordon McComb, MD (Los Angeles, CA)

INTRODUCTION: While focal radiation therapy to the brainstem remains the mainstay of treatment for Diffuse Intrinsic Pontine Glioma (DIPG), a definitive relationship between radiation-induced tumor size reduction and enhanced survival has not been objectively established.

METHODS: Under an IRB approval, a retrospective analysis of all patients with a diagnosis of DIPG primarily treated with focal radiation within the last 10 years was undertaken. Manual segmentation by two different experts was used to map tumor volumes.

RESULTS: 21 patients(12 female) met the above criteria. The median age at diagnosis was 7years. All primarily received radiation: 30-33 fractions of Intensity modulated radiotherapy (IMRT) ranging between 4500-6000cGy was administered over a mean period elapsed over 40days. Concomitant chemotherapy was administered in 12 patients. Post-irradiation MR scans were obtained after a mean interval of 5 weeks. The median survival was 11 months(range: 4-28months). There was net reduction in lesion volume in 19 patients and interval increase in size in 2. In the former, the median percentage reduction was 58%(+/-SD 28) whereas the overall median volumetric reduction was 120.8cm3. Statistically, a greater than 50% reduction in tumor volume was associated with a significantly improved survival(p=0.04). The median survival time ranged from 9.6m in tumors that showed lesser than 50% reduction to 11.3m in those with a <50% reduction. The presence or absence of concomitant chemotherapy, when analyzed independently, was not a statistically significant factor for increased survival.

CONCLUSIONS: A radiation-induced reduction in tumor volume by a factor greater than 50% may modestly prolong survival in children with DIPGs.

127. DOES THE POST-OPERATIVE PRESENCE OF AN ENHANCING CYST WALL IN PILOCYTIC ASTROCYTOMA INDICATE HIGHER RISK OF TUMOR RECURRENCE?

Christine Bui; Yasser Jeelani, MD; John Grimm, MD; Andrew Yousef; Stephanie Da Silva, BA; J. Gordon McComb, MD; Mark Krieger, MD (Irvine, CA)

INTRODUCTION: Debate exists as to the need to resect enhancing cyst walls in children with pilocytic astrocytoma (PA). This study aims to establish whether post-operative residual enhancing cyst walls in PAs are associated with a worse prognosis.

METHODS: An IRB-approved retrospective analysis was performed on children treated for cystic PA at a single institution between 2000 and 2012. Both pre- and post-operative MRIs were analyzed for the presence of an enhancing cyst wall.

RESULTS: 51 children (27 male) presented with cystic PA (10 supratentorial; 41 infratentorial). The median age at diagnosis was 8.8 years (range: 2.7-16.9). Mean follow-up was over 4 years (range:1month-10years). 31 patients presented with enhancing cyst walls; postoperatively, 13/31(42%) had residual enhancing cyst wall. Overall, 13/51 patients had tumor progression/recurrence. In 12/13 cases, progression occurred at the site of gross residual tumor. 7 patients with gross total resection of the solid tumor and postoperative enhancing cyst walls were followed for an average of over 3 years without tumor recurrence or progression. Using Fisher's exact test, there was no statistically significant relationship between the presence of an enhancing cyst wall post-op and tumor recurrence or progression.

CONCLUSIONS: Residual cyst wall is not a risk factor for tumor recurrence. The goal of surgery should be to resect the solid tumor. There is no need to surgically resect the full extent of the enhancing cyst wall.

128. ENDOCRINE OUTCOMES AFTER SURGERY FOR PEDIATRIC CRANIOPHARYNGIOMA

Tene A. Cage, MD; Aaron Clark, MD, PhD; Derick Aranda, MD; Andrew Parsa, MD, PhD; Peter Sun, MD; Kurtis Auguste, MD; Nalin Gupta, MD, PhD (San Francisco, CA)

INTRODUCTION: Currently, there is no consensus on the optimal management for craniopharyngioma. There is difficulty achieving a balance between reduced recurrence rates and acceptable morbidity. We examined endocrine dysfunction following craniopharyngioma treatment in patients who had varying degrees of resection and adjuvant radiation therapy (XRT).

METHODS: We performed a systematic review of the literature of pediatric patients with histologically confirmed craniopharyngiomas. Post-operative endocrine outcomes were measured with respect to extent of resection (EOR) including biopsy, subtotal resection (STR) with or without XRT, and gross total resection (GTR). Chi-square was used to compare outcomes. Logistic regression was used to determine odds ratios for outcomes by EOR.

RESULTS: Disaggregated data from 109 peer reviewed articles resulted in 531 subjects. Of these, 348 subjects had documented post-operative endocrine outcomes. After GTR, patients had higher rates of adrenal insufficiency, hypothyroidism, and diabetes insipidus compared to STR (p=0.01, p=0.04, and p=0.009). When comparing GTR to STR with adjuvant XRT, GTR was associated with higher rates of adrenal insufficiency, hypothyroidism, and diabetes insipidus (p=0.03, p=0.03, and p=0.05). When XRT was added as an adjunct therapy to STR, there was an increased rate of panhypopituitarism (p=0.003).

CONCLUSIONS: We suggest that a greater EOR is associated with a greater risk of endocrine dysfunction. In addition, when adjunct XRT is used after STR, it is associated with increased risk of pituitary dysfunction. Despite limitations of a retrospective review of the literature, this study suggests that higher rates of endocrine dysfunction are associated with a greater EOR or use of adjuvant XRT.

129. ENDOSCOPIC THIRD VENTRICULOSTOMY WITH CHOROID PLEXUS CAUTERIZATION IN PREMATURE INFANTS WITH POSTHEMORRHAGIC HYDROCEPHALUS

Ricky H. Wong, MD; Peter Warnke, MD; David Frim, MD; Sandi Lam, MD (Chicago, IL)

INTRODUCTION: There is growing literature showing that endoscopic third ventriculostomy (ETV) with choroid plexus cauterization (CPC) is an effective treatment for hydrocephalus even in young populations (<1 year of age) with certain diagnoses, though the viability of this procedure in premature infants with posthemorrhagic hydrocephalus has yet to be fully explored.

METHODS: We report on a retrospective series of 5 premature infants with posthemorrhagic hydrocephalus treated with ETV/CPC.

RESULTS: Five premature infants (average gestational age 25.5 weeks, range 22.7 weeks to 28.9 weeks) with Grade 3 or 4 IVH and hydrocephalus with demonstrated need for CSF diversion. Four were treated with ETV/CPC, while the fifth was treated with CPC alone due to poor visualization from friable ependyma. Average calendar age at ETV/CPC surgery was 13.7 weeks, range 11 to 17.5 weeks. All 5 patients had a period of improvement followed by progressive hydrocephalus requiring permanent shunting relatively early in the postoperative period (average calendar age of 24.3 weeks at shunt implantation surgery, range 20 to 34 weeks).

CONCLUSIONS: All premature infants with posthemorrhagic hydrocephalus in this series failed ETV/CPC an average 8.5 weeks postoperatively and required another surgery for CSF diversion. The pathophysiology needs to be further examined to understand predictors of success and the timeframe to failure in these very young neonatal ICU infants. Larger scale studies are needed. Initial results in this series suggest that shunt freedom may not be readily attainable in this patient population.

130. ENDOSCOPIC FENESTRATIONS FOR SUPRASELLAR ARACHNOID CYSTS

Elias B. Rizk, MD; Shane Tubbs, PhD; Jerry Oakes, MD; John Wellons, MD, MSC; Joshua Chern, MD; James Johnston, MD, MSC; Curtis Rozzelle, MD; Jeffrey Blount, MD (Harrisburg, PA)

INTRODUCTION: The endoscopic treatment of a suprasellar arachnoid cyst (SAC) consists mainly of ventriculocystostomy (VC) and ventriculocystocisternostomy (VCC). The authors report on the effectiveness of endoscopic VC for SACs.

METHODS: The authors retrospectively analyzed the surgical results of patients with a SAC treated using endoscopic fenestration. The patient charts were reviewed for clinical presentations and clinical and radiologic outcomes between 1993-2010.

RESULTS: 11 patients were consecutively treated using endoscopic fenestration at the Children's Hospital of Alabama. Age at presentation ranged between 4.5 months to 11 years. Adolescent patients presented with headaches while infants had either motor delay or increased head circumference. Cyst volume was calculated using the formula to calculate the volume of an ellipsoid $4/3\pi;(A/2)(B/2)(C/2)$, where A, B, and C are the three diameters. If π; is estimated to be 3, then the volume of an ellipsoid becomes ABC/2. No significant changed occurred in the size of the cyst on follow up imaging. All patients had slowing of head circumference growth and resolution of their presenting symptoms. None of the patients developed postoperative complications.

CONCLUSIONS: Endoscopic management to treat suprasellar arachnoid cysts is a viable and safe option in the management of these congenital malformations.

131. ENDOSCOPIC REMOVAL OF AN INTRAVENTRICULAR PNET TUMOR: RETRIEVAL OF A FREE-FLOATING FRAGMENT USING UROLOGIC BASKET RETRIEVER

Scott Zuckerman, MD; Kevin Carr, BS; Luke Tomycz, MD; Matthew Pearson, MD (Nashville, TN)

INTRODUCTION: The endoscopic resection of intraventricular tumors represents a unique challenge to the neurological surgeon. These neoplasms are invested deep within the brain parenchyma and are situated among neurologically vital structures. Additionally, the cerebrospinal fluid system presents a dynamic pathway for resected tumors to be mobilized and entrapped in other regions of the brain.

METHODS: In 2011, we treated a 3 year old female with a third ventricular mass identified on stereotactic brain biopsy as a WHO Grade IV tumor. After successful neoadjuvant chemotherapy, endoscopic surgical resection was performed.

RESULTS: Despite successful resection of the tumor, the operation was complicated by mobilization of the resected tumor and entrapment in the atrial horn of the lateral ventricle. Using a urologic stone basket retriever, we were able to retrieve the intact tumor without additional complications.

CONCLUSIONS: The flexibility afforded by the nitinol urologic stone basket was useful in the endoscopic removal of a free-floating intraventricular tumor. This device may prove to be useful for other practitioners performing these complicated intraventricular resections.

132. ETIOLOGY AND MANAGEMENT OF SYNDROME OF THE TREPHINED FOR PATIENTS WITH VP SHUNTS

Ato Tafarra Wallace; BS; Luke Tomycz, MD; Kevin Carr, BS (Nashville, TN)

INTRODUCTION: In patients who are given decompressive hemicraniectomy followed by ventriculoperitoneal shunting for CSF malabsorption, the skin flap can sometimes become sunken coincident with neurological deterioration. This unique disorder, likely under-reported in the literature, has been characterized by some experts as the "syndrome of the trephined". These patients are notoriously difficult to manage, may be hospitalized frequently, and their optimal treatment course remains controversial.

METHODS: In this study we examined the clinical course of two patients who underwent decompressive hemicraniectomy, and subsequently shunted with a programmable VP shunt, following traumatic brain injury. Both patients developed the "syndrome of the trephined." Their treatment and outcome were considered, and recommendations were made based on a comprehensive review of the literature.

RESULTS: Both patients experienced a tumultuous clinical course characterized by multiple hospitalizations and episodes of neurological decline. Their course presentation was attributed primarily to over-shunting and the presence of a sunken skin flap. Recovery was very marginal following shunt reprogramming, but symptoms drastically improved after cranioplasty.

CONCLUSIONS: "Syndrome of the trephined" is a unique and likely heterogeneous condition observed in some patients with cranial defects who undergo decompressive hemicraniectomy and CSF shunting. The condition is primarily attributed to a sunken skin flap, but here we postulate that shunting malfunction is significant. Shunt reprogramming in concert with cranioplasty generally provide the cornerstone interventions in the management of these difficult patients. The etiology of the condition and the recommended management course for these patients was discussed.

133. EVALUATING INFECTION TRENDS IN A PEDIATRIC ACUTE CARE FACILITY

Chevis Shannon; Steven Veselsky; Kyle Aune; Amita Bey; Anastasia Arynchyna; John Wellons, MD, MPH (Birmingham, AL)

INTRODUCTION: This study evaluates the results of a multidisciplinary quality improvement initiative to reduce infections. We describe results of a single institution experience pre/post protocol changes.

METHODS: A taskforce of ten departments was established to investigate an increase in neurosurgical infections. The task force identified 67 institution specific variables associated with infection. A retrospective chart review of all pediatric neurosurgical procedures between 2009 and 2012 was conducted. Data was analyzed using SAS 9.3.

RESULTS: 1,127 patients, undergoing 2,282 neurosurgical procedures were identified. Gestational age, multiple admissions and length of stay were statistically signification ($p<.0001$). Premature infants were 2.5 times more likely to be infected than term infants. Patients with more than 3 admissions were 15 times more likely to be infected than patients with only one visit. Patients admitted more than 5 days were 8.2 times more likely to be infected than patients admitted 3 days or less. Odds of developing an infection were 3.2 times higher ($p<0.0001$) for each additional procedure occurring during a continuous hospital stay. Infection rates pre/post process changes were not statistically significant; however, we do not have adequate follow up data to accurately determine the significance surrounding process changes.

CONCLUSION: As previous literature has addressed, the premature infant population and increased length of stay leads to increased risk of infection. Our study further defined the significant risk associated with hospital stays and multiple procedures. We continue to evaluate our practice patterns to investigate institution specific predictors of infection risk.

134. EVALUATION OF ATLANTO-OCCIPTAL DISLOCATION USING THE OCCIPITAL CONDYLE-C1 INTERVAL MEASUREMENT IN A PEDIATRIC LEVEL 1 TRAUMA CENTER

Colin John Kazina, MD; Walavan Sivakumar, MD; Jay Riva-Cambrin, MD, MSC; Douglas Brockmeyer, MD (Winnipeg, Canada)

INTRODUCTION: Atlanto-occipital dislocation (AOD) is a relatively common problem in pediatric trauma. The occipital condyle-C1 interval (CCI) measurement is useful in the identification of patients with AOD. CCI's of less than 2mm and greater than 4 mm reliably delineate normal from craniocervical dislocation, respectively. Patients with intermediate CCI measurements (2to 4 mm) are more complex. We report our experience with diagnosing and managing AOD, with emphasis on patients with intermediate CCI measurements.

METHODS: 33 patients were identified as having craniocervical dislocations. 3 patients expired during initial resuscitation. 6 did not have CT scans available and were excluded from analysis. Patients were divided into 3 CCI groups: less than 2 mm, 2 to 4mm, and greater than 4 mm. Radiographic findings of the intermediate measurement group were analyzed by modality, with fusion as the primary outcome.

RESULTS: Of the 24 patients reviewed, 3 had bilateral CCI measurements of less than 2 mm and 5 had bilateral CCI measurements of greater than 4 mm. 16 patients had intermediate CCI measurements. Of the intermediate group, MRIs were available in 15 patients, and flexion-extension x-rays of the cervical spine were available in 5 patients. MRI and flexion-extension x-rays have false positive rates of 67% and 50% respectively.

CONCLUSIONS: In AOD patients with intermediate CCI measurements, MRI and flexion-extension x-rays may not be reliable in assessing the true extent of occipital-cervical instability. This data supports the premise that CT with CCI measurements should be the primary determinant in diagnosing AOD.

135. EXECUTIVE FUNCTION AFTER PEDIATRIC TBI: A SYSTEMATIC REVIEW

Shobhan H. Vachhrajani, MD; Ashwin Sankar, BS; Abhaya Kulkarni, MD, PhD (Toronto, Canada)

INTRODUCTION: Executive function (EF) encompasses multiple cognitive processes that control purposeful, goal directed behavior. EF deficits are common after pediatric traumatic brain injury (TBI). We performed a systematic review of the literature to ascertain the profile of EF deficits and patterns of recovery after pediatric TBI.

METHODS: Medline, EMBASE, CINAHL, and PsycInfo electronic databases were searched. Search terms included executive function, brain injuries, and pediatrics. Studies with non-TBI or adult populations, non-EF outcomes, or where EF data was not provided were excluded, as were abstracts, book chapters and review articles. Quality of evidence was assessed using the GRADE framework.

RESULTS: Of 1261 initial studies retrieved, 88 were retained for full text review. All were prospective cohort studies, and were of moderate quality. Multiple measures of EF were used; direct comparison of study results was challenging. TBI patients showed significant problems with sustained and shifting attention, inhibition control, planning, and problem solving compared to controls. Those of younger age, severe TBI, and lower socioeconomic status performed poorly. Functional MRI and diffusion tensor imaging implicates the right dorsolateral frontal cortex and genu of the corpus callosum. EF deficits persist 10 years after TBI but long-term recovery is possible.

CONCLUSIONS: Children show significant EF deficits after TBI, and are affected for many years after their injury. Such deficits have notable impact on social integration, academic performance, and the child's ability to be successful in adulthood. Early multidisciplinary intervention is necessary to promote optimal outcome.

136. FACTORS ASSOCIATED WITH HEMISPHERIC HYPODENSITY (HH) AFTER SUBDURAL HEMATOMA (SDH) FOLLOWING ABUSIVE HEAD TRAUMA (AHT) IN CHILDREN

Matthew Jacob Recker; Kimberly Foster, MD; Michael Bell, MD; Patrick Kochanek, MD; P. David Adelson, MD; Robert Clark, MD; Elizabeth Tyler-Kabara, MD, PhD (Duncansville, PA)

INTRODUCTION: Abusive head trauma is a unique form of TBI with increased mortality and sequelae. HH after SDH affecting large areas of cortex have been described (BigBlack Brain1). Risk factors for HH are not understood.

METHODS: We hypothesized risk factors could be identified for HH. Children with AHTadmitted to the pediatric ICU were enrolled. Records (prehospital, physiologic and radiologic) were interrogated. HH was determined by a blinded observer.

RESULTS: HH (n = 13 of 24 enrolled) was not associated with age (15.4 mo ± 3.3 vs. 12.1 mo +/-; 3.0) or initial GCS (7.2 +/– 1.2 vs. 5.2 +/– 0.4). Daily PILOT scores (pediatric intensity level of therapy) and daily ICPmax were higher in HH (p=0.01 and p=0.037, respectively). Hypoxia (69.2% vs. 27.3%), hypotension (23.2% vs. 0%), and cardiac arrest (30.7% vs. 9.0%) tended to be greater in HH, as did mortality (46.1% vs. 18.1%).

CONCLUSIONS: A variety of insults appear to be associated with HH after SDH -intracranial hypertension, hypoxia, hypotension, and cardiac arrest. Classic neurosurgical paramaters- initial GCS , pupillary abnormality, initial radiographic finding- do not predict HH. Other blood products (epidural hematoma, traumatic subdural hematoma, intraparenchymal contusion) do not correlate. Given the prevalence of this morbid condition, larger studies to identify mechanisms and mitigating clinical approaches are warranted. 1Duhaime et al., Prog Brain Res 161:293-302, 2007

137. WITHDRAWN

138. FEASIBILITY, SAFETY, AND INDICATIONS FOR SURGICAL BIOPSY OF INTRINSIC BRAINSTEM TUMORS IN CHILDREN

Tene A. Cage, MD; Sonia Samagh, MD; Sabine Mueller, MD, PhD; Theodore Nicolaides, MD; Daphne Haas-Kogan, MD; Michael Prados, MD; Anu Banerjee, MD; Kurtis Auguste, MD; Nalin Gupta, MD, PhD (San Francisco, CA)

INTRODUCTION: Diffuse intrinsic pontine gliomas (DIPGs) are rapidly progressive and pathologically aggressive tumors that usually arise in children. Their anatomic location makes gross total surgical resection impossible and fewer than 10% of patients survive more than two years after diagnosis. In the absence of a tissue diagnosis, treatment planning for chemotherapy or radiation can be difficult. We reviewed the results of surgical biopsy of pontine tumors in children at a single institution and compared our results to those available in the literature.

METHODS: A historical cohort study was performed using medical records of patients under the age of 18 who underwent surgical biopsy of an intrinsic pontine tumor at a single institution. Fourteen patients underwent stereotactic biopsy, two had open biopsies, and one had an attempted surgical resection.

RESULTS: Ten male and 7 female patients were included. Age at presentation ranged from 8 months to 17 years (average 7.5 years).The pathologic diagnoses of the tumors were both high and low grade. Eight were high grade (WHO grade III or IV), 8 were WHO grade II tumors, and 1 was a pilocytic astrocytoma (WHO grade I). There were no intraoperative complications and only one patient developed a new post-operative neurologic deficit.

CONCLUSIONS: Stereotactic biopsy of brainstem tumors is a definitive method for obtaining tissue for a pathologic diagnosis and is associated with low morbidity. This technique can be performed safely and will be important for directing multimodality clinical trials involving chemotherapy, radiation therapy, or other biologically-driven therapies for children with intrinsic brainstem tumors.

139. WITHDRAWN

140. GLIOMA EXOSOMES MODULATE LOW GRADE GLIOMA ANGIOGENESIS

Prajwal Rajappa, MD; Caitlin Hoffman, MD; Yujie Huang, PhD; Ayuko Hoshino, PhD; Joon Kim, BS; Bruno Silva, PhD; Hector Selgas, PhD; David Lyden, MD, PhD; Jeffrey Greenfield, MD, PhD (New York, NY)

INTRODUCTION: WHO Grade II gliomas transform into higher grade gliomas exhibiting neovascularization.We purified brain tumor-derived exosomes, subcellular particles carrying genetic material. Exosomes are derived from tumor cells, fuse with a still undefined population of cells to support tumor growth. We explored their functional role and describe here a novel role for exosomes in supporting neoangiogenesis during glioma transformation.

METHODS: The RCAS PDGF-driven model was used to create a spontaneous low-grade murine glioma. Tumor-bearing mice were injected for 4 weeks with purified high-grade glioma-derived exosomes. Fusion of exosomes with various tumor-associated cell populations including bone-marrow derived cells was characterized. Flow cytometry was used to quantify myeloid and endothelial precursor cell mobilization and to identify their immunophenotypes. Human brain endothelial and low-grade glioma cell lines were used to examine the effects of exosomes upon cell proliferation.

RESULTS: MRIs after a 4-week exosome exposure period demonstrate heterogeneous, ring-enhancing lesions in exosome-injected animals compared with controls. Brain cross sections reveal hyperproliferative and invasive tumors demonstrating newly formed vasculature. Endothelial precursor cells are mobilized peripherally and at the tumor site. Exosomes appear to preferentially incorporate within myeloid-derived suppressor cells (CD11b/GR1+). Human brain endothelial cells and low-grade glial cell lines proliferate extensively when co-incubated with human high grade glioma-derived exosomes.

CONCLUSION: High-grade glioma-derived exosomes may mediate cellular cross-talk between tumors and a myeloid-derived subset of immune cells, promoting neovascularization of low grade gliomas. The genetic cargo within, and specificity of these exosome mediated interactions continues to be examined.

141. HAJDU-CHENEY SYNDROME AND BASILAR IMPRESSION: REVIEW AND CASE REPORT

Cristina Barrena, MD; Mikel Armendariz, MD; Alicia Bollar, MD; Agustin Nogues, MD; Enrique Úrculo, MD (San Sebastian, Spain)

INTRODUCTION: Hajdu-Cheney syndrome is characterized by dissolution of the terminal phalanges, hearing loss and early tooth loss. This progressive congenital bone pathology is able to produce occipitocervical instability, foramen magnum syndrome and basilar impression. Nevertheless this pathology is very rare and no general consensus has been reached about the management of these patients.

METHODS: Due to a case report in our department, a review is made with craniovertebral junction, basilar impression, Hajdu-Cheney syndrome, osteochondrodysplasias and acro-osteolysis keywords. Management, clinical progression and election treatment was the objective of our clinical research.

RESULTS: A nine years girl is reported with history of development delay and undetermined syndromic characteristic since 3 years old. Neurological symptoms began at 9 years old with ataxia and low cranial nerve palsies. On a previous magnetic resonance imaging, no severe basilar impression was seen, however this skull base abnormality was evolutionated 17 months later along with progressive platybasia and type I chiari malformation. The surgery procedure was: external traction during three days, occipitocervical fixation with posterior craniectomy and external immobilization using halo brace during two months. Radiological reduction and clinical improvement were achieved.

CONCLUSIONS: Little is known about natural history of Hajdu-Cheney syndrome. The craniocervical hallmark of these patients is basilar impression caused by severe and progressive osteopenia and bone dysplasia (mutation in NOTCH2). Adolescent stage is the interval of time in which there may be progression of basilar impression; consequently closely follow up has to be done to prevent potentially devastating skull base pathology.

142. IMAGING CHARACTERISTICS IN SYMPTOMATIC AND ASYMPTOMATIC CHILDREN WITH CHIARI 1 MALFORMATION

Sanjiv Bhatia, MD, FAANS, FACS; Matthew Green, BA; O Roberts, MD; Parthasarathi Chamiraju, MD; John Ragheb, MD (Miami, FL)

INTRODUCTION: Incidental Chiari I Malformation (CIM) is often noted on MRI scans performed for unrelated reasons. While most of these children are asymptomatic and do not require surgical intervention some may develop symptoms on long term follow up. Anatomic and dynamic MR imaging features related to CMI that may predict this risk are not known.

METHODS: Clinical records of 20 asymptomatic children with CMI with an insignificant or no syrinx were compared with a second group of 20 patients with symptomatic CMI. 14 of these patients had significant syringomyelia. The MRI data reviewed included level of descent and shape of the cerebellar tonsil, the amount of CSF surrounding the tonsil and CSF flow at the foramen magnum.

RESULTS: The position of the tonsils varied from 5 to 20 mm below the foramen magnum in both groups - 13.3 mm (mean) in the surgical group and 11.7 mm (mean) in the asymptomatic group. In the surgical group the tonsils were pointed in 19 and CSF flow was normal in 7/20 patients. In the asymptomatic group tonsils were pointed in 16 and CSF flow was diminished in 10/20 patients. The amount of CSF at the foramen magnum was diminished in all but one patient in the surgical group.

CONCLUSIONS: No individual MR finding correlated with the presence of clinical symptoms nor could it predict the presence of a significant syrinx. An MR based scoring system may allow statistical analysis to identify variables that predict the risk of developing symptoms in asymptomatic Chiari patients.

143. IMPROVEMENT IN HINDBRAIN CSF FLOW ON CINE MRI FOLLOWING EXTRADURAL DECOMPRESSION FOR CHIARI I MALFORMATION

Michael DiLuna, MD; Ryan Grant, MD, MS; Virginia Waldrop, BA; Avital Perry, BS (New Haven, CT)

INTRODUCTION: Posterior fossa decompression remains the standard surgical treatment for symptomatic Chiari I malformation, with improvement in hindbrain CSF dynamics seen on cine MRI following intradural opening. We examined whether CSF flow dynamics improved, with corresponding symptomatology, following exclusively extradural decompression.

METHODS: Patients undergoing surgery for Chiari I malformation underwent pre- and post-operative CINE phase-contrast MR imaging. The association of age, sex, tonsillar ectopia, symptoms, syrinx, and Hoffman's sign were assessed using a logistic regression model to calculate odds ratios with 95% confidence intervals and Chi Square goodness of fit to assess for model variance.

RESULTS: Mean +/- SD age at time of surgery was 29.8 +/- 14.0 years. Eight (88.9%) of the patients had improvement in CSF flow on cine MRI, with all these cases correlating to improved or resolved symptomatology. The relief of symptoms or improvement in CSF hindbrain flow did not function as a degree of age (OR = 0.88 [95% CI = 0.67 - 1.16], p = 0.37) or tonsilar ectopia (OR = 0.00 [95% CI = 0.00 - 0.00), p = 0.99). Employing an interaction model with each variable did not produce statistical change. In most instances, intra-operative CINE images (iMRI) showed immediate improvement of CSF flow dynamics with purely extradural decompression.

CONCLUSIONS: Extradural posterior fossa decompression for Chiari I improves hindbrain CSF flow on CINE phase-contrast MRI with a corresponding relief of symptoms. These improvements are not secondary to preoperative demographics, tonsilar herniation, or neurological status.

144. INCIDENCE OF SEVERE IVH AND POST-HEMORRHAGIC HYDROCEPHALUS IN THE MODERN ERA

Luke Tomycz, MD; Andrea Brock, BS; Steven Steele, RN; William Walsh, MD; Noel Tulipan, MD (Nashville, TN)

INTRODUCTION: Intraventricular hemorrhage (IVH) continues to be one of the main causes of morbidity and mortality in premature infants. We sought to identify the scope of the problem in the era of modern prenatal and neonatal care.

METHODS: Using an established institutional database, we identified all the preterm infants (EGA < 40 wks) born at Vanderbilt Children's Hospital (VCH) from January 2006 to December 2011. We excluded those with a birth weight over 1500 g, focusing only on the very-low-birth-weight (VLBW) infants who have a particular predisposition to intraventricular hemorrhage. Within this cohort, we identified the subset of patients who required temporary or permanent CSF diversion. A ventricular access device was used for temporary CSF diversion and a VP shunt was used for permanent diversion. Serial LPs and ventriculo-subgaleal shunts were not utilized in any patient.

RESULTS: A total of 1383 preterm, VLBW infants were included in the study. Approximately 35% of these neonates developed IVH of prematurity, and 11.3% suffered from severe IVH (Grade III or Grade IV). A total of 25/1383 (1.8%) developed post-hemorrhagic hydrocephalus requiring a neurosurgical intervention for temporary or permanent CSF diversion. Presented as a fraction of those infants with Grade III or Grade IV IVH, 25/157 or 15.9% of the neonates required CSF diversion.

CONCLUSIONS: Improved prenatal and neonatal care has decreased the need for neurosurgical interventions to treat post-hemorrhagic hydrocephalus in premature, VLBW neonates.

145. INTERACTIONS BETWEEN PROGRAMMABLE SHUNT VALVES AND THE IPAD 3 WITH SMART COVER

Yizheng He; Rory Murphy, MD; Jarod Roland, MD; David Limbrick, MD, PhD (St. Louis, MO)

INTRODUCTION: In patients with programmable CSF shunt valves, the risk of unintentional valve adjustment associated with the environmental magnetic influence is ever present. We tested whether an iPad 3 could change the pressure settings of the Strata NSC Adjustable Pressure Valve, Strata NSC Burr Hole Valve, Strata II small valve, Sophysa Polaris model SPV, and Aesculap valve proGAV by using direct fluoroscopic visualization.

METHODS: The left front edge (LFE) of the iPad 3 with smart cover had the strongest magnetic flux, measuring approximately 1200 gauss. The LFE was first moved linearly at approximately 30 cm/s over the test valve from various directions at various distances. Then the LFE was rotated at varying distances above the valve at approximately 1 radian/s.

RESULTS: Almost all shunt valves were immune to reprogramming by the iPad 3 at varying distances including direct contact. However, we found that rotating the peak flux location at 4 mm above the Strata II small valve, we were able to change the valve pressure settings every time.

CONCLUSIONS: The iPad 3 can change pressure settings of the Strata II small valve at a distance comparable to the thickness of certain regions of scalp. Although the specific rotational motion described here is likely rare in real life, we nevertheless recommend that children with hydrocephalus, caregivers, educators, and therapists are informed of the now-apparent risks of close contact with this increasingly popular technology.

146. INTRACRANIAL INFANTILE HEMANGIOPERICYTOMA: CASE REPORT AND REVIEW OF THE LITERATURE

Brian Jeffrey McHugh, MD; Jacob Baranoski, BS; Ajay Malhotra, MBBS; Alexander Vortmeyer, MD; Gordon Sze, MD; Charles Duncan, MD (New Haven, CT)

INTRODUCTION: Intracranial infantile Hemangiopericytomas (HPCs) are rare lesions that behave less aggressively than their adult counterparts. Here we present a case of infantile intracranial HPC, review the literature, and propose that infantile intracranial HPCs are in fact misclassified cases of infantile myofibromatosis.

METHODS: We present the case of a 2 month old with intracranial HPC and conduct a comprehensive review of the available literature focusing on the evolving concept of what defines HPC, and how that might relate to clinical behavior.

RESULTS: Pre-operative MRI demonstrates a left frontal extra-axial mass (2.8 x 2.2 x 3.0 cm), mildly hypointense on T1-weighted images and heterogenously mildly hyperintense on T2-weighted images. There is marked but mildly heterogeneous enhancement, with mild spiculation of the outer surface of the tumor on contrast imaging. The tumor was removed en bloc. Histologically the tumor is highly vascularized with intermediate-sized round and spindle-shaped neoplastic cells with polymorphic nuclei. A subset of tumor cells are positive for CD34, and numerous tumor cells are positive for both smooth muscle-actin and muscle-specific actin suggestive of myofibromatous differentiation. At 28 months post-resection, MRI imaging reveals no evidence of recurrence. Additionally the unique feature of intralesional extramedullary hematopoeisis was observed.

CONCLUSIONS: When compared to their adult counterparts infantile hemangiopericytomas have a relatively benign clinical course despite typically aggressive appearing histology. We propose infantile intracranial HPCs represent an immature form of myofibroblastic/pericytic lesions of infancy. A so-called "true" HPC (immature infantile myofibromatosis) has been discussed in the literature with peripheral infantile HPCs.

147. INTRACRANIAL CYSTS AND SPORTS: EVALUATING THE RISK OF INJURY

Jennifer Mae Strahle, MD; Meleine Martinez; Hugh Garton, MD; Karin Muraszko, MD; Cormac Maher, MD (Ann Arbor, MI)

INTRODUCTION: Intracranial cysts are frequently found incidentally; however have the potential to rupture. It is unknown whether participation in sports increases the risk for rupture or bleeding.

METHODS: Surveys on sport participation were administered to consecutive patients with intracranial cysts in pediatric neurosurgery clinic at the University of Michigan between 12/2010 and 7/2012.

RESULTS: 107 patients were included and 79% were male. Mean age at cyst diagnosis was 7.5 years (-0.2-21) and age at time of survey was 9.7 years (0-21). There were 94 patients with arachnoid cysts, 5 with pineal cysts, 5 with multiple arachnoid cysts and 3 with both pineal and arachnoid cysts. There were 107 arachnoid cysts in 102 patients with 43% located in the middle fossa and 33% in the posterior fossa. 19 patients had a history of surgical treatment for their cyst. 61 (57%) patients participated in 25 different sports, with 54 participating in contact sports. The most frequently played sports included soccer (n=28), baseball (n=26), and basketball (n=24). The group participated in 508 years of sports with an average of 8.61 years/person, and 4 months/year per sport. There was one case of arachnoid cyst rupture after a football game and one case of a subdural hematoma in a patient with an arachnoid cyst after heading a soccer ball. Both patients fully recovered and did not require treatment.

CONCLUSIONS: Complications of cysts in sports appear to be low, but further prospective study is needed.

148. INTRAOPERATIVE MRI FOR CERVICAL SPINAL CORD TUMORS

Mark Daniel Van Poppel, MD; Frederick Boop, MD; Asim Choudhri, MD (Memphis, TN)

INTRODUCTION: Intramedullary spinal neoplasm resection is challenging, requiring balance between the therapeutic benefit of gross-total resection (GTR) and the risk of functional deficits. Intraoperative Magnetic Resonance Imaging (iMRI) has been successful intracranially, however the equipment is not designed to guide spinal surgery. We report 2 cases of intramedullary cervical cord neoplasms resected using a modified iMRI technique for guidance.

METHODS: Two patients with cervical intramedullary neoplasms underwent resection with iMRI guidance. Intraoperative electrophysiologic monitoring was performed in both patients, with leads disconnected prior to MRI. A modified coil placement technique and head positioning was developed to facilitate effective imaging of the cervical spine. After identification of tumor margins and resection of visible neoplasm, 3 Tesla iMRI was performed to evaluate for residual disease. Real-time consultation was performed between the neurosurgeon and the neuroradiologist.

RESULTS: In patient one, iMRI identified residual disease, which was resected. Subsequent imaging demonstrated GTR, including a 3month post-operative examination. In patient two, iMRI showed gross-total resection of the cervical intramedullary neoplasm without residual tumor. Motor and sensory function was stable in both patients. Pathologic diagnosis in both cases was pilocytic astrocytoma.

CONCLUSIONS: 3T iMRI can be safely performed on the cervical spine in pediatric patients with intramedullary neoplasms. The intraoperative identification of residual tumor can improve the chances of a gross-total resection while minimizing the chances of functional deficits. Modern iMRI setups allow standard instrumentation to be used during resection, including the use of electrophysiologic monitoring.

149. INTRAOPERATIVE CONFIRMATION OF ACCURATE VENTRICULAR CATHETER PLACEMENT

Tyler S. Auschwitz, MD; Frederick Boop, MD; Paul Kliom, MD, MPH; NIckalus Khan, BS; Mark VanPoppel, MD; Michael Muhlbauer, MD (Memphis, TN)

INTRODUCTION: Recent literature shows, image guidance for cerebrospinal fluid shunting leads to more accurate placement of the proximal catheter. Accurate ventricular catheter placement is usually not verified until a postoperative CT is performed. We analyze the feasibility, limitations, and accuracy of using the Medtronic O-Arm to verify placement of the catheter in the ventricle intraoperatively.

METHODS: We evaluated 5 pediatric patients, including both new shunt placement and revisions. The Medtronic O-Arm was used to verify accurate placement of the ventricular catheter. In 2 cases frameless neuronavigation was used to guide positioning and in 3 cases anatomic landmarks were utilized. All 5 patients underwent evaluation of ventricular placement using the O-arm.

RESULTS: Five patients (ages 3month-12yr) underwent intraoperative imaging with the O-arm to attempt confirmation of accurate catheter placement. Etiology being post-traumatic for 2 patients, post tumor resection, pseudotumor and aquaductal stenosis. 3 of the 5 were easily interpreted showing verification of the catheter in the ventricle. The 2 cases in which intraoperative catheter placement failed was secondary to artifact related to head immobilization and operating room equipment.

CONCLUSIONS: The O-Arm has been used in the pediatric operating room for primarily spine instrumentation. The cranial software that was developed will now allow the O-Arm to be used in a multitude of cranial cases. Multiple lessons were learned and will be applied going forward to improve this new technology. This study shows the feasibility of intraoperative confirmation of ventricular catheter placement using the Medtronic O-arm.

150. INTRAVENTRICULAR HEMORRHAGE AND VENTRICULOPERITONEAL SHUNT REVISION: A RETROSPECTIVE REVIEW

Mark Calayag, MD; Alexandra Paul, MD; Matthew Adamo, MD (Albany, NY)

INTRODUCTION: Intraventricular hemorrhage (IVH) after revising a proximal ventriculoperitoneal shunt (VPS) catheter is a known complication, however there is sparse literature describing the hemorrhage and re-revision rates. We retrospectively reviewed our proximal VPS revisions to determine our rates of IVH and early revision.

METHODS: The medical records of our pediatric patients who underwent a revision of their VPS from 2009 to 2012 were reviewed. We included patients with: 1) proximal catheter revisions and 2) post-operative imaging within three days. This identified 52 patients. The difficulty of removing the catheter, IVH on imaging, and re-revision within one month were recorded. A Student's t-test was performed for statistical analysis.

RESULTS: Twenty-five percent of patients had evidence of IVH, with two percent having an IVH greater than 5ml Fifteen percent of patients with IVH required a revision within one month, compared to eighteen percent that underwent a revision without a prior IVH, however this was not significant. Difficulty removing the catheter was significantly associated ($p<0.01$) with an increase in IVH (62%). The percentage of patients who underwent revision after the removal of a difficult catheter was less than those that were felt to be routine (8% vs. 59%).

CONCLUSIONS: Removal of a proximal VPS catheter carries a risk of IVH, but this may not be clinically significant in terms of needing an early revision. This may be taken into consideration when deciding to remove an existing catheter or just placing a new catheter.

151. ISOLATED CERVICAL SPINAL CANAL STENOSIS AT LEVEL OF THE ATLAS IN CHILDREN

Sohum K. Desai, MD; Sudhakar Vadivelu, DO; Akash Patel, MD; Andrew Jea, MD (Galveston, TX)

INTRODUCTION: Isolated cervical canal stenosis at the level of the atlas, or C-1, is a rare cause of cervical myelopathy. It has been documented in spondyloepiphyseal dysplasia congenita, Down syndrome, and Klippel-Feil. The purpose of this study was to highlight our experience with 4 additional pediatric cases, review the literature, and report a previously undocumented association with Williams syndrome.

METHODS: The medical records and radiologic imaging studies of four patients treated at Texas Children's Hospital for symptomatic hypoplasia of the atlas was retrospectively reviewed. Pertinent patient demographics, clinical presentation, imaging findings, and outcomes after surgery were recorded.

RESULTS: Of the children in our series, there were 4 males. The average age in our pediatric series was 5.27 years (range, 13 months - 13 years). Mean sagittal diameter of the spinal canal at the level of the atlas was 9.88 mm (range, 8.3 - 11.4 mm). Two patients with hypoplasia of the atlas were associated with Williams syndrome which has not been previously described. Patients were followed for an average 7 months (range, 2 weeks-15 months) and none experience any post-operative complications. Laminectomy of C1 provided neurological improvement in all patients presented.

CONCLUSIONS: Congenital hypoplasia of the atlas is a rare cause of cervical myelopathy. We hope that this report will prompt the clinician to consider it when searching for an etiology for signs and symptoms of cervical myelopathy, especially in children.

152. LEPTOMENINGEAL ENHANCEMENT AS A DIAGNOSTIC AND PROGNOSTIC INDICATOR IN ATYPICAL TERATOID/RHABDOID TUMOR

Ira Eugene Bowen; Yasser Jeelani, MD; Stephanie DaSilva, BA; J. Gordon McComb, MD; Mark Krieger, MD (Los Angeles, CA)

INTRODUCTION: Atypical Teratoid Rhabdoid Tumors (AT/RT) are a rare primary CNS tumor of childhood. Although they can be indistinguishable from medulloblastomas on imaging, AT/RTs tend to have a poorer prognosis.

METHODS: This IRB-approved study retrospectively reviewed 24 children with AT/RT between 2000 and 2012. The average age at diagnosis was 4.8 years; 11/24 (46%) were female. Pre and postoperative MRIs were evaulated for tumor size and location, leptomeningeal enhancement, extent of resection, and presence of calcification, cysts, hemorrhage, and necrosis. Results were compared with 83 age matched patients with medulloblastoma. Magnetic Resonance Spectroscopy was available for 9 of the AT/RT patients.

RESULTS: Mean overall follow-up for the group was 38 months (23 months for AT/RT and 42months for medulloblastoma). The average overall survival (OS) for AT/RT patients was 21.7months vs. 41months for medulloblastoma patients (p= 0.03). The OS for males with AT/RT was 17months vs 39 months for females(p = .05). 8 of 24 (33%) AT/RTs presented with leptomeningeal enhancement vs 8 of 83 (9%) in medulloblastomas. No significant difference was seen in the OS in AT/RT patients presenting with leptomeningeal enhancement vs those without, 25 and 26 months respectively. At 23 months the mortality for AT/RTs was 13/24 (54%).

CONCLUSIONS: AT/RTs are more likely to have leptomeningeal enhancement at presentation compared with medulloblastoma. As expected, prognosis for AT/RT was statistically worse than for medulloblastoma. While leptomeningeal enhancement was more likely to occur in AT/RT it did not prove indicative of a poorer prognosis.

153. LOW MORBIDITY OF MR-GUIDED LASER THERMOABLATION FOR HYPOTHALAMIC HAMARTOMA

Daniel J. Curry, MD; Jerome Boatey, MD; Sudhakar Vadivelu, DO; Thomas Luerssen, MD; Robert Dauser, MD; Andrew Jea, MD; Robert Bollo, MD; Angus Wilfong, MD (Houston, TX)

INTRODUCTION: Hypothalamic Hamartomas are rests of ectopic neurons that cause gelastic epilepsy in children and adults. The epileptic syndromes are highly resistant to medical therapy requiring surgical intervention as the only chance for cure; many techniques for surgical intervention have been developed with different balances of efficacy and morbidity. MR- Guided Laser interstitial Thermal Therapy a new minimally invasive approach to the treatment of drug-resistant gelastic epilepsy. Morbidity of the first series of cases is reported.

METHODS: Eight patients with intractable gelastic epilepsy related to a hypothalamic hamartoma underwent MgLITT of the lesion. Charts of the patients were reviewed for evidence of morbidity. Special attention was given to hemorrhagic complications, infections, memory disturbance, visual changes, hormonal complications, affect changes, and changes in consciousness.

RESULTS: All eight patients underwent MRgLITT of their HH. There are all free of gelastic seizures after the ablation. There was one asymptomatic subarachnoid hemorrhage at the tract. Three patients complained of non-specific non-disabling lethargy. There were no incidences of diabetes insipidus. One patient had a prolonged state of lethargy with an idiopathic reaction to iv phenytoin. One patient had post-op memory deficit that resolved with steroids.

CONCLUSIONS: MR-Guided Laser Thermoablation of Hypothalamic Hamartoma is a safe and effective alternative to open resection without the need for ionizing radiation in young patients.

154. MANAGEMENT OF RUPTURED DISSECTING INTRACRANIAL ANEURYSMS IN INFANTS: REPORT OF 4 CASES AND REVIEW OF THE LITERATURE

Andrew Jea, MD; Vikas Y. Rao, MD; Robert Bollo, MD; William Whitehead, MD; Daniel Curry, MD; Robert Dauser, MD; Thomas Luerssen, MD (Houston, TX)

INTRODUCTION: Ruptured dissecting intracranial aneurysms in the pediatric population are infrequent and those occurring in infants less than 1 year old are extremely rare. We review our experience with ruptured spontaneous intracranial dissecting aneurysms in infants less than 1 year old.

METHODS: A retrospective review of our patient database from Mid-2007 to Mid-2012 with ruptured aneurysms was performed. Of these cases, infants 1 year old or less with imaging consistent with an intracranial dissection were identified.

RESULTS: During the study period, 4 infants 1 year old or less were treated for ruptured distal dissecting intracranial aneurysms at Texas Children' Hospital. In all cases, mycotic aneurysms and collagen vascular disorder were excluded. All patients in our series presented with subarachnoid hemorrhage and 3 of the 4 had intraventricular hemorrhage as well. All patients in this series were managed in the acute or subacute period with surgical (1 patient) or endovascular (3 patients) trapping without distal bypass procedures. The patients tolerated sacrifice of the parent vessels feeding these distal aneurysms well and all have made excellent functional recoveries.

CONCLUSIONS: Based on a review of our small case series, we find that intracranial dissecting aneurysms presenting with hemorrhage have an overall good prognosis. We recommend treating this pathology in infants aggressively with either surgical or endovascular trapping. Infants may tolerate sacrifice of the parent artery well, without the need for a bypass procedure. This is likely due to their robust collateral circulation, and their exquisite plasticity and capacity to recover from neurological injury at this age.

155. MESIAL TEMPORAL PARAMETERS INFLUENCING THE EXTENT OF THERMOABLATION

Daniel J. Curry, MD; Sudhakar Vadivelu, DO; Angus Wilfong, MD (Houston, TX)

INTRODUCTION: MR- Guided Laser interstitial Thermal Therapy (MRgLITT) is a new minimally invasive approach to the treatment of intractable epilepsy in children. Preliminary evidence has shown that the shape of the lesion is heavily dependent upon local tissue thermodynamics, with cisternal and ventricular surfaces dissipating thermal energy and reducing tissue ablation. The medial curvature of the mesial temporal structures around the ambient and crural cisterns presents a particular challenge to amygdalohippocampal ablation through a single occipitotemporal pass with a 20 mm maximal ablation diameter. We measured the maximum medial extent of mesial temporal lobe from two possible ablation trajectories in a series of children with epilepsy.

METHODS: Fifty patients, aged 8 mo to 19 years, with intractable epilepsy underwent routine T2 weighted MRI of the brain. At a ponto-mesencephalic axial slice, two occipitotemporal ablation trajectories were drawn, one immediately lateral to the choroidal point, and another angled trajectory through center of the head of the hippocampus. The distance from the cistern to the trajectory was recorded.

RESULTS: In the medial ablation vector, 18% of the patients had medial tissue beyond the maximal ablation diameter, whereas in the lateral approach 61% had uncus beyond the radius of ablation. In addition, there was significant variability in the medial extent of uncus after the age of 9 years.

CONCLUSIONS: MR-Guided Laser Thermoablation of the mesial temporal lobe may be more complete from a medial trajectory. In patients where the medial uncus is more that 10mm from the ablation trajectory, and transtemporal ablation should be considered

156. MOYAMOYA DISEASE WITH MESIAL TEMPORAL SCLEROSIS: CASE REPORT

Subash Lohani, MD; Joseph Madsen, MD; Ann Bergin, MD; Edward Smith, MD (Boston, MA)

INTRODUCTION: Moyamoya is a cerebrovascular condition that predisposes affected patients to stroke in association with progressive stenosis of the intracranial internal carotid arteries and their proximal branches. To date we are unaware of reports linking moyamoya with mesial temporal sclerosis (MTS).

METHODS: We retrospectively reviewed the chart of a patient who underwent a single stage operation for moyamoya and MTS.

RESULTS: This five year old patient started having seizures at three months. Initial evaluation revealed a right temporal arachnoid cyst, right medial temporal cortical dysplasia and right MTS. Seizure was controlled on medications. At age 5, he began to manifest new symptoms suggestive of TIA. Imaging revealed right-sided arteriopathy consistent with moyamoya. It was decided that revascularization was needed for progressive moyamoya. Debate centered over the likelihood of needing surgical treatment for MTS later in life. Given the difficulty in performing a lobectomy in the setting of established collateral vessels, a single stage operation was planned. The sequence was: (i) dissection of the STA, (ii) frontotemporal craniotomy (iii) mesial temporal lobectomy (with intraoperative corticography and fenestration of the cyst), (iv) pail synangiosis. Post-operative course was uneventful. He had no further seizures or stroke and 6 month postoperative MRI revealed excellent collaterals with reversal of the previous ivy sign.

CONCLUSIONS: This case demonstrates the co-existence of MTS and moyamoya. The finding of dual intracranial pathology in moyamoya mandates careful consideration of potential future surgical needs. Resection of an intraparenchymal lesion can be performed successfully with a pial syangiosis under a single anesthetic.

157. MOYAMOYA DISEASE: TWO DIFFERENT TECHNIQUES IN THE SAME PATIENT - CASE REPORT AND SURGICAL CONSIDERATIONS

Alexandre Casagrande Canheu, MD (Cianorte, Brazil)

INTRODUCTION: Moyamoya disease is described as hypoplasia of bilateral internal carotid arteries. The treatment is clinical medical devices, encephalo-duro-arterio-myo-synangiosis, arterial shunts or multiple burr-hole to improve the brain vascularization. Case Report: A 6 year old boy presented right hemiparesis with motor afasia. Imaging studies showed classical features of moyamoya disease at the left side. He had been operated on two years ago in another hospital because he had presented left hemiparesis and drowsiness. The images had showed hipodense image in right frontal lobe and occlusion of right middle cerebral artery, beside signs of bilateral moyamoya disease. It has been performed encephalo-duro-arterio-myo-synangiosis at the right side.

METHODS: At the surgery after exposure of temporal muscle and pericranium, several triangular shapes incisions were made in the pericranium allowing one-inch burr hole just beneath of each incision. The dura mater and arachnoid were opened under magnification to expose the pial vessels. Finally we slipped each leaf of pericranium into the respective burr-hole allowing the contact between pial vessels and pericranium. We've done eight burr-holes covering the entire left skull convexity.

RESULTS: The patient has been followed up for 36 months showing no symptom of motor or language dysfunction. The cerebral angiography shows better pial anastomosis at the left side as well as more intense arterial irrigation.

CONCLUSIONS: Surgical treatment offers the best results and benefits for moyamoya disease, but no standard surgical treatment is established. At least for this case, multiple burr-holes technic could improve brain vascularization better than encephalo-duro-arterio-myo-sinangiosis.

158. NON-OPERATIVE CLINICAL OUTCOMES IN CHIARI I MALFORMATION PEDIATRIC PATIENTS

Amy Killeen; Alexis Chavez; Mark Henry; Carl Heilman, MD; Steven Hwang, MD (Boston, MA)

INTRODUCTION: While post-operative outcomes of pediatric Chiari I malformation patients have been well-reported, there is a paucity of literature concerning non-operative management in these patients. We conducted an analysis of clinical outcomes in Chiari I patients treated conservatively.

METHODS: We retrospectively identified pediatric patients (age ≤ 18 years) with a diagnosis of Chiari I malformation who were not recommended for surgery based on lack of clinical objective findings or lack of consistent cough headaches. We analyzed clinical data and followed up with patients via phone survey.

RESULTS: Of 19 patients (mean age: 13.2 +/- 3.2 years, follow up: 160.9 +/- 101.2 months), 10 were asymptomatic when diagnosed with a Chiari I malformation, presenting with trauma, seizures, head tilt, scoliosis, irritability and developmental delay. One asymptomatic patient later developed migraines. Two patients presented with cough headaches (one tussive and one whose behavioral symptoms suggested cough headaches). Both patients had resolution of their symptoms. 3 patients had their non-specific headaches resolve while 2 patients saw improvement in these headaches (one was prescribed gabapentin). 2 patients had their parasthesias and emesis resolve while the 4 patients with syrinxes did not develop any new symptoms.

CONCLUSIONS: In our study, we found that all symptoms of pediatric patients either improved or resolved over time. Although we are limited by a small series, this corroborates the importance of patient selection as a critical factor in deciding who benefits from surgical intervention and can help assure families that symptoms will likely improve.

159. WITHDRAWN

160. PATENT FORAMEN OVALE AND CONGENITAL CRANIOSYNOSTOSIS: MANAGEMENT CONSIDERATIONS AND ASSOCIATED RISKS

Samer K. Elbabaa, MD, FAANS; Saadeh Al-Jureidini, MD; Alexander Lin, MD (St. Louis, MO)

INTRODUCTION: Patent foramen ovale (PFO) is a cardiac anomaly that can potentially allow emboli to travel from venous to arterial circulation,which could lead to coronary infarction or stroke. In congenital craniosynostosis, surgical repair has the risk of air embolism. When both conditions coincide, the management is unclear. Both early PFO repair and delayed craniosynostosis repair carry their own unique risks. We present two patients with both craniosynostosis and PFO to discuss potential management options and outcomes.

METHODS: Inclusion criteria were patients with craniosynostosis and PFO treated with a multidisciplinary approach which includes a pediatric neurosurgeon, pediatric craniofacial plastic surgeon and an interventional pediatric cardiologist.

RESULTS: Patient A. 2-year-old with Jacobsen syndrome including metopic craniosynostosis, Paris-Trousseau platelet disorder and cardiac anomalies including PFO. He received percutaneous PFO occlusion several months prior to craniosynostosis repair. No neurologic nor cardiac complications after both procedures completed. Patient B. 9-month-old with metopic craniosynostosis and PFO whose cardiac anatomy did not allow early patching. Instead, PFO was temporarily occluded with balloon catheterization during a simultaneous craniofacial correction surgery in the hybrid operating suite. During early postoperative period, patient was noticed to have a mild right arm weakness. CT and MRI scans confirmed a small acute infarct near the left internal capsule. Echocardiography demonstrated no ongoing thrombogenic etiologies. Radiographically and clinically, the infant recovered very well.

CONCLUSIONS: Patients with simultaneous craniosynostosis and PFO are unique and complex, requiring an individualized approach from a multidisciplinary team to best inform the parents of the risks and benefits of intervention. Different management considerations include early percutaneous endovascular repair or simultaneous temporary balloon occlusion of PFO during craniofacial correction.

161. PATTERNS OF CARE FOR CRANIOPHARYNGIOMA: SURVEY OF AANS MEMBERSHIP

Cesar Augusto Serrano Almeida, MD; Sarah Williams; Nicholas Palmeri, BA; Michelle Torok, PhD; Michael Handler, MD; Arthur Liu, MD, PhD; Todd Hankinson, MD (Aurora, CO)

INTRODUCTION: Initial therapy for craniopharyngioma remains controversial. Recent analyses indicate that traditional algorithms (gross total resection versus subtotal resection with radiation) are not employed in many cases. We endeavored to verify these findings and investigate neurosurgical practice patterns for patients with craniopharyngioma.

METHODS: A nine question survey was designed and electronically distributed to 2974 AANS members as an AANS Special Announcement. Responses were collected through Zoomerang and analyzed using standard statistical techniques.

RESULTS: One hundred two responses were collected (3.43% response rate). 36% of respondents estimated their practice to include <75% pediatric patients and 61% described their practice as academic. 36% of respondents indicated that, under certain circumstances, they would recommend observation or radiation therapy for a suspected craniopharyngioma in the absence of a tissue diagnosis, with 46% of these indicating this recommendation in <10% of cases. Following GTR, 90% of respondents never recommend adjuvant RT. Following STR, 35% always recommend RT and 59% recommend it in over half of cases. However, following STR or tissue biopsy alone, 18% and 11%, respectively, never recommend XRT. There was no correlation between respondent's type of practice (i.e. academic or <75% pediatrics) and practice patterns.

CONCLUSIONS: Although conclusions are limited by a low response rate, a considerable subset of patients with craniopharyngioma are not treated with the algorithms that are most commonly described in the academic literature. Further investigation regarding the presentation and outcomes of these patients may help shape future therapies.

162. PEDIATRIC BRAIN TUMORS AND HYDROCEPHALUS

Rabia Qaiser, MD; David Lancton, BS; Daniel Guillaume, MD (Minneapolis, MN)

INTRODUCTION: Hydrocephalus is common in children with brain tumors and can be secondary to direct obstruction by the tumor, and/or secondary changes that can interfere with cerebrospinal fluid clearance. In this study, the authors aimed to determine the percentage of children with brain tumors who have hydrocephalus and the odds of having hydrocephalus based on tumor location.

METHODS: A retrospective cohort was created using the 2009 Kids' Inpatient Database to identify children younger than 21years of age with brain tumors, hydrocephalus or both. Hydrocephalus and brain tumor was ascertained by ICD-9 diagnosis codes. Data was retrieved and odds ratio was calculated using SAS (Statistical Analysis Software).

RESULTS: In this sample, 2,634 children had a primary diagnosis of any brain tumor(Cerebrum: 202; Frontal: 208; Temporal: 208; Parietal: 108; Occipital: 51;Ventricle: 270; Cerebellum: 500; Brain Stem: 315; Other: 772). Of the children with tumors, 963(36.6%) had a secondary diagnosis of hydrocephalus (23 communicating, 933 obstructive, 7 congenital). The proportion with associated hydrocephalus varied between brain tumor locations with the lowest being temporal (4.8%) and the highest being brain stem (36.5%), cerebellum (42.0%) and ventricular (61.1%). The odds of having hydrocephalus with an infratentorial tumor (odds=0.66) was 6.15 times higher than for supratentorial tumors (odds=0.11).

CONCLUSIONS: Hydrocephalus was a secondary diagnosis in 36.6 % of all patients with brain tumors especially with ventricular and posterior fossa tumors. Further studies will identify associations with histology, and hydrocephalus treatment (shunting versus endoscopic third ventriculostomy).

163. PEDIATRIC SKULL BASE CHORDOMAS: SURGICAL RESULTS AFTER ENDOSCOPIC ENDONASAL SURGERY

Elizabeth Tyler-Kabara, MD, PhD; Maria Koutourousiou, MD; Paul Gardner, MD; Stephanie Henry; Carl Snyderman, MD (Pittsburgh, PA)

INTRODUCTION: Pediatric skull base chordomas are aggressive tumors usually requiring multimodality treatment.

METHODS: We retrospectively reviewed the medical files of 10 pediatric patients (age: 4-8 years, 80% male) who underwent endoscopic endonasal surgery (EES) for clival chordomas.

RESULTS: Clinical presentation included cranial nerve palsies (60%) and headache (40%), while 2 patients were asymptomatic. They all underwent EES, combined with open approaches (far lateral or transcervical) in 4 cases. Three patients underwent two-stage approaches and one required 7 surgeries (5 EES and 2 far lateral craniotomies). Gross total resection was achieved in 70%, near total (<95%) in 20% and subtotal (<85%) in 10%. Two required occipito-cervical fusion postoperatively. Presenting symptomatology was improved or resolved in every case. Surgical complications included cerebrospinal fluid leak in 2 patients treated with surgical exploration and lumbar drain placement, and carotid laceration in one case requiring carotid occlusion, resulting in a Horner's syndrome without further complications. As part of the initial treatment, 7 patients (70%) received adjuvant radiotherapy after surgery (proton beam in 6 cases, conventional radiotherapy in one). With a mean follow-up period of 32 months (2-68 months), 6 patients remain free of disease and 4 showed recurrence: one with aggressive deterioration received chemotherapy but died within 5 months, 2 with minimal recurrence are in close follow-up and one was re-operated twice for multiple recurrences.

CONCLUSIONS: EES represents a safe and feasible surgical technique for the treatment of pediatric skull base chordomas with results comparable if not even better than open approaches.

164. POSTERIOR LUMBAR INTERBODY FUSION IN CHILDREN

Julian J. Lin, MD; Ahmad Issawi, MD; Alex Hass, BS (Peoria, IL)

INTRODUCTION: Spondylolysis in children is uncommon; surgery is indicated for slip progression, high-grade slip with sagittal imbalance, neurologic deficit, and pain unresponsive to prolonged conservative treatment.

METHODS: Retrospective case series of 7 pediatric patients undergoing treatment with transforaminal lumbar interbody fusion (TLIF) and modified Speed procedure.

RESULTS: All patients had failed conservative management and subsequently six underwent L5-S1 TLIF, one L4-5 TLIF, and one modified L4-S1 Speed procedure. Average age was 14.6. Male to female ratio was 1:1. Average follow up period was 15 months. Five patients with low grade lishtesis underwent L5-S1 TLIF, one underwent L4-L5 TLIF. Of them one patient had a post op infection and one later developed spondylolysis at a higher level. One patient with grade 3 listhesis woke up with post op weakness which improved after relaxation of the reduction. One patient with grade 5 spondylolisthesis underwent the modified Speed procedure. All patients had improvement or resolution of their symptoms on follow up.

CONCLUSIONS: The results of our case series suggest that TLIF procedures for spondylolisthesis provide adequate resolution of symptoms with low risk of complication. Patients with higher-grade spondylolisthesis undergoing TLIF may have greater risk for complications.

165. PRACTICE TRENDS IN THE UTILIZATION OF INTRAOPERATIVE NEUROPHYSIOLOGICAL MONITORING IN PEDIATRIC NEUROSURGERY

Sudhakar Vadivelu, DO; Satish Agadi, MD; Robert Schmidt; Prasitha Mani; Akash Patel, MD; Sohum Desai, MD; Sabih Effendi, MD; Christopher Glover, MD; Thomas Luerssen, MD; Andrew Jea, MD (Houston, TX)

INTRODUCTION: The Decade of the Brain in the 1990s introduced higher benchmarks in safety for patients, adult and pediatric, undergoing neurosurgery. We identified current trends in the utilization of intra-operative neuro-monitoring (IONM) as an adjunct to neurosurgery in our practice at the Division of Pediatric Neurosurgery at Texas Children's Hospital.

METHODS: A total of 4,467 neurosurgical procedures were performed in 2,352 pediatric patients from 2008 - 2011. A retrospective chart review examining surgeon, procedure, patient characteristics, and pre-operative complications were recorded based on whether IONM was used or not.

RESULTS: During the 4-year period, the percent of neurosurgical procedures performed with IONM increased approximately 12% to a high of 34%. Surgeon-related factors where IONM was more likely used included surgeons < 10 years in practice, procedure-related factors included posterior spinal fusions, and patient-related factors included children older than 3 years of age and with one or more comorbidities. The neurological complication rate of cases performed with IONM ranged from 2.4-6.9%, averaging 4.7% is low compared to cases without IONM (range from 3.1-10.1%, average of 7.23%).

CONCLUSIONS: Substantial trends were observed in our practice. The percent of procedures performed with IONM increased during the 4-year period. Younger surgeons with subspecialty interest performed spine or posterior fossa surgeries in older children with significant comorbidities were most likely to use IONM. This is the first study to examine practice trends in the use of IONM in pediatric neurosurgery.

166. PREDICTING INCIDENCE OF CSF DIVERSION PROCEDURES IN PEDIATRIC PATIENTS WITH POSTERIOR FOSSA TUMORS

Liliana C. Goumnerova, MD, FAANS, FACS; Sarah Jernigan, MD, MPH (Boston, MA)

INTRODUCTION: Hydrocephalus is associated with posterior fossa tumors. There are variable rates reported for shunting. We reviewed our 10 year data and PHIS data for the same time period to define rates of shunting, practice patterns and institutional indications for shunting.

METHODS: We performed a retrospective review of all patients with the diagnosis of posterior fossa tumors treated at our institution and from the PHIS database utilizing ICD9 and CPT codes. SAS was utilized for statistical analysis. Patients who had undergone primary surgical resection elsewhere were not included.

RESULTS: We identified 141 patients from 2006 until 2010, inclusive, who underwent surgery for posterior fossa tumors. 13 of 141 (9.2%) underwent insertion of a VP shunt after resection of their tumor, none of them underwent ETVs. 3 of these patients were high risk according to the CPPRH criteria and the remaining 10 were low risk. 12 of 13 had moderate to severe hydrocephalus. However, moderate to severe hydrocephalus was present in 54 patients (38.3%) and only 22.2% required shunting. CPPRH score was calculated for all patients and only 3 of our shunted patients were in the high risk group. 10 of 128 (7.8%) were high risk but did not require a CSF diversion procedure. The PHIS data will also be presented to provide national practice pattern information.

CONCLUSIONS: Our institutional rate for CSF diversion was substantially lower than that reported in other large case series. The CPPRH score did not correlate with shunting and this may reflect difference in practice patterns.

167. PRIMARY GLIOBLASTOMA OF THE CEREBELLUM IN CHILDREN: REPORT OF 5 CASES AND REVIEW OF THE LITERATURE

Andrew Jea, MD; Gaddum Reddy, MD, PhD; Anish Sen, MD; Akash Patel, MD; Robert Bollo, MD (Houston, TX)

INTRODUCTION: Primary cerebellar glioblastomas (GBM) in children are rare. As a result, an optimal treatment strategy has not yet been identified. A review of the characteristics of the disease as well as the effectiveness of various therapeutic modalities would help in optimizing the treatment paradigm.

METHODS: We performed a detailed clinical, radiographic, and pathologic retrospective review of five patients (3 boys and 2 girls; average age at presentation 7.2 years [range, 3-14 years]), and surveyed the literature for an additional 55 cases.

RESULTS: Computed tomography and magnetic resonance imaging usually revealed a large lesion with minimal edema, heterogenous contrast enhancement, and a discrete border. Subtotal tumor resection was performed in two patients; gross total resection in three patients. Immunostaining of the tumor cells with antisera to glial fibrillary acidic protein and vimentin was variably positive. Adjuvant therapy included local radiation and chemotherapy in all followed patients. Tumor recurrence was seen in two patients. Patients were followed from 2 months to 3.5 years (mean, 12 months). Two patients were dead at last followup with a mean survival of 9.5 months.

CONCLUSIONS: The prognosis for pediatric patients with cerebellar glioblastomas is dismal, even when compared to adult counterparts or other malignant posterior fossa tumors in children. Cerebellar glioblastomas have a tendency to recur disseminate despite treatment with surgery, chemotherapy and radiation. The poor outcomes seen with this tumor suggests that the optimal treatment strategy has yet to be elucidated and much work needs to be done.

168. PROGNOSTIC FACTORS ASSOCIATED WITH SURVIVAL AND DECISION-MAKING IN PEDIATRIC CRANIAL GUNSHOT WOUNDS

Michael George DeCuypere, MD; Kyle Gabrick, BS; Paul Klimo Jr., MD, MPH; Frederick Boop, MD; Michael Muhlbauer, MD (Cordova, TN)

INTRODUCTION: Penetrating traumatic brain injury (TBI) is less common than blunt, but more severe, with cranial gunshot wounds (GSW) being associated with high morbidity and mortality. Not unexpectedly, the majority of literature on intracranial GSW focuses on adults with little on the management and outcomes in children. The goal of this study is to identify clinical and radiographic factors predictive of outcome.

METHODS: A retrospective review of isolated GSW to the head with intracranial injury from birth to 18 years at two major metropolitan Level 1 trauma centers from 1996-2012 (N=65). Several standard clinical and radiographic factors were reviewed and analyzed for predictive value in survival and overall outcome.

RESULTS: Overall mortality reached 48%, with 62% of survivors achieving favorable clinical outcome (GOS ≥ 4). Seven independent factors for survival were identified: initial ICP < 30 mm Hg, ≥ 1 reactive pupil, absence of deep nuclear injury, single hemispheric involvement, absence of transventricular trajectory, < 3 lobe injury, and absence of midline shift (P<0.05). Age was not associated with survival. Additionally, low hematocrit and high base deficit were associated with death (P<0.05). This may reflect longer transit time to medical care and/or acute high intravascular volume loss.

CONCLUSIONS: This series of pediatric cranial GSWs underscores the importance of initial clinical exam, imaging characteristics, and adequate resuscitation in clinical decision-making. The factors identified may be useful to the physician in making decisions and counseling families.

169. PROGNOSTIC ROLE FOR DIFFUSION-WEIGHTED IMAGING OF DIFFUSE INTRINSIC PONTINE GLIOMA

Michael Edwards, MD; Robert Lober, MD, PhD; Kristen Yeom, MD; Yujie Tang, PhD; Sonia Partap, MD; Yoon-Jae Cho, MD; Paul Fisher, MD; Terri Haddix, MD; Michelle Monje, MD, PhD (Stanford, CA)

INTRODUCTION: We investigated whether diffusion-weighted imaging helps predict the clinical course for diffuse intrinsic pontine glioma (DIPG).

METHODS: We compared survival between groups of DIPG patients stratified based on tumor apparent diffusion coefficient (ADC). Correlative histology was available in three patients.

RESULTS: Median age at diagnosis was 6.6 (range 2.3 to 13.2) years, with median follow-up seven (range one to 20) months. There were 14 boys and six girls. Seventeen patients received radiotherapy, five received chemotherapy, and six underwent CSF diversion. The median ADC of 1295 x 10-6 mm2/s for the cohort partitioned tumors into low or high diffusion groups, which had distinct median survivals of three months and 13 months, respectively (log-rank p = 0.001). Low diffusion tumors were found only in boys, whereas high diffusion tumors were found in both boys and girls. At autopsy, two available low diffusion tumor specimens demonstrated high grade (grade III to IV) histology, whereas the one available high diffusion tumor demonstrated low grade (grade II) histology. Autopsy data from one patient demonstrated a metastatic periventricular nodule with higher grade histology than what was found in pons, with corresponding lower diffusion in the lesion on imaging.

CONCLUSIONS: Diffusion-weighted imaging might be useful for predicting tumor behavior and stratifying patients in prospective studies that assess treatment response.

170. WITHDRAWN

171. REGIONAL WHITE MATTER CHANGES DETECTED BY DIFFUSION TENSOR IMAGING IN EXPERIMENTAL NEONATAL HYDROCEPHALUS

James P. (Pat) McAllister II, PhD; Ramin Eskandari, MD; Osama Abdullah, MS; Kelley Lloyd, MS; Angela Freeman, BS; Melissa Packer, BS (Salt Lake City, UT)

INTRODUCTION: Diffusion tensor imaging (DTI) may be valuable for assessing white matter damage in vivo during hydrocephalus, but cytopathological correlations, and thus knowledge of pathophysiological mechanisms, are lacking. We used our well-established experimental model to further explore these correlations.

METHODS: Hydrocephalus was induced in two week-old felines by intracisternal kaolin injections. Ventricular reservoirs were placed one (early, n=6) or two (late, n=3) weeks post-kaolin and tapped based exclusively on neurological deficits. Integrity of the internal capsule (IC) and corpus callosum (CC) was evaluated before reservoir placement and every three weeks with DTI fractional anisotropy (FA) and mean diffusivity (MD). Brains from hydrocephalic and age-matched control (n=3) animals sacrificed at 12 weeks post-reservoir were processed for immunocytochemistry.

RESULTS: In IC, FA and MD were unchanged in early and late hydrocephalic animals compared to controls but astrocytosis was significantly elevated in early (p= 0.001) and late (p=0.031) groups. Late animals, however, demonstrated significantly lower astrocytosis (p = 0.014) than early animals. The CC demonstrated appreciable decreases in FA and increases in MD in both in early and late animals compared to controls at three weeks post-reservoir placement (p=0.004 and 0.055, respectively).

CONCLUSIONS: Hydrocephalic animals treated with intermittent ventricular reservoir tapping using clinical criteria alone demonstrated white matter alterations that were detectable by DTI and were structure-specific, i.e. the CC was much more affected than the IC. Astrogliosis in the IC, however, was not coupled to DTI measurements, suggesting that in some white matter structures DTI may not detect important cytopathology.

172. SAFETY OF CORPUS CALLOSOTOMY AND VAGAL NERVE STIMULATION IN PEDIATRIC EPILEPSY

Mark Daniel Van Poppel, MD; James Wheless, MD; Frederick Boop, MD; Stephanie Einhaus, MD; Stephen Fulton, MD; Amy McGregor, MD; Katherine Van Poppel, MD; Paul Klimo, MD (Memphis, TN)

INTRODUCTION: Vagal nerve stimulation (VNS) and corpus callosotomy (CC) are effective palliative procedures for reducing seizure frequency in refractory epilepsy. It is assumed that VNS placement has fewer surgical complications compared to CC, which influences the decision for choosing a palliative procedure. We analyzed a large modern pediatric population with refractory epilepsy comparing the safety of both procedures.

METHODS: All cases of VNS placement, VNS revision or corpus callosotomy performed between 2005 and 2012 were reviewed for surgical complications. The cases were performed at a single pediatric institution by 3 surgeons.

RESULTS: 75 patients underwent CC with a surgical complication rate of 6%. CC complications included 1 delayed hematoma, 2 infected bone flaps, 1 pseudomeningocele, and 1 aborted procedure. 170 patients underwent VNS placement or revision with a surgical complication rate of 5%. VNS complications included 6 infections, 1 vocal cord paralysis, and 2 sterile inflammatory reactions. No patient in either group had permanent morbidity or mortality. Forty percent of patients undergoing CC had a VNS placed prior, and 10% percent of patients had concurrent VNS placement and CC. Less than 1% of patients underwent CC prior to undergoing VNS placement.

CONCLUSIONS: Many believe VNS therapy is a safer procedure than CC, however in this pediatric population VNS therapy carried equal surgical risk with no permanent disability in either group. In treatment of refractory epilepsy, VNS therapy was considerably more common than CC despite similar surgical risks.

173. SECONDARY DISSEMINATION OF MEDULLOBLASTOMAS IN CHILDREN

Sara Ghayouri; Yasser Jeelani, MD; Stephanie DaSilva, BA; J. Gordon McComb, MD; Mark Krieger, MD (Tallahassee, CA)

INTRODUCTION: One-third of medulloblastomas disseminate over the course of the disease. These disseminated tumors carry an extremely poor prognosis; however, risk factors and patterns of dissemination have been poorly described to date.

METHODS: Under IRB approval, a retrospective analysis was performed on all patients at a single institution with a histological diagnosis of medulloblastoma over a 10 year period with complete clinical and radiographic follow-up. Dissemination patterns were analyzed.

RESULTS: Fifty-seven patients (33 male) were identified. The mean age at diagnosis was 7.5 years. Median follow-up was 3.7 years. All were treated under standard protocols. Six had disseminated disease at presentation; 1 was under 3 years of age and 5 were older. 21 had dissemination during their disease course; 3 were under age 3 and 18 were older. 13/21(61%) of children with secondary dissemination had gross total resection of their tumors initially. Survival after secondary dissemination was on average 13.7 months. Age, histology, location, and size of tumor did not impact the rate of secondary dissemination. Secondary dissemination did not independently impact survival in young children, but was associated with a worse outcome in children over 3 years of age (p=0.04).

CONCLUSIONS: Secondary dissemination of medulloblastomas is relatively common, and can occur even when there is gross total resection of the tumor on presentation. Secondary dissemination was shown to convey a worse prognosis in standard risk patients (i.e., older children).

174. SHUNT INFECTIONS IN CHILDREN LESS THAN ONE YEAR OF AGE

Meysam Ali Kebriaei, MD; Steven Salinas, BS; Falkenstrom Kristina; William Boydston, MD, PhD; Barun Brahma, MD; Andrew Reisner, MD; David Wrubel, MD; Joshua Chern, MD, PhD (Atlanta, GA)

INTRODUCTION: Children less than one year of age are unique in their physiology and comorbidities. Literature suggests the risk for shunt infection may be different in this population compared to those of an older age.

METHODS: In the 3-year period between 2009 to 2011, 284 CSF shunts were inserted in children less than one year of age at our institution. Clinical characteristics and shunt infections were prospectively recorded in the practice and hospital database. Multivariate analysis was utilized to delineate risk factors for shunt infections.

RESULTS: The study included 270 patients. Average gestational age was 27.2 weeks, and average birth weight was 1065 grams. Average weight at time of shunt insertion was 4281 grams. 63 patients had a ventricular access device (VAD) inserted prior to shunt insertion, 37 patients underwent myelomeningocele closure, and 72 patients underwent other invasive procedures (defined as VAD insertion, shunt revision, open or laparoscopic G-tube insertion, open abdominal procedures, and open cardiac procedure) within 30 days of shunt insertion. Shunt infection occurred in 21 patients (19 with organism isolated and 2 with abdominal pseudocyst). Multivariate analysis showed invasive procedure within 30 days to be the only risk factor that predisposed the patient to shunt infection (O.R 8.1, p=0.0024).

CONCLUSIONS: The results of this study suggest that invasive procedure within 30 days of shunt insertion is associated with a higher risk of shunt infection in children whose shunt was inserted prior to one year of age.

175. SKULL BASE SURGERY IN PEDIATRIC PATIENTS: A SINGLE INSTITUTIONAL ANALYSIS OF 75 CASES

Timothy Ryan Owens; Ranjith Babu, BS; Timothy Miller, MD; Renee Reynolds, MD; Herbert Fuchs, MD; Carrie Muh, MD; Takanori Fukushima, MD; Gerald Grant, MD (Durham, NC)

INTRODUCTION: The goal of this study is to examine the application of skull base surgical techniques in a pediatric population. The literature regarding surgical management of pediatric skull base lesions is very limited; therefore, we examined our institution's experience.

METHODS: This is an IRB approved retrospective review of a consecutive series of patients below the age of 18 who underwent a neurosurgery procedure using a skull base approach between 01/01/2000 and 7/01/2012. The cohort was derived using Duke University's DEDUCE querying tool and was extracted based on CPT codes corresponding to the skull base procedures performed.

RESULTS: Seventy-five cases were identified with 41 boys and 34 girls. The mean age was 10.3 years and median follow-up was 22.2 months (mean = 48). Twenty-two types of intracranial pathology were represented with schwanommas and craniopharyngioma being the most common (32%). The most common approaches were anterolateral and transphenoidal. Gross total resection was achieved in 58% of cases. Fifty-two percent of pathologies were noted to be attached to adjacent neural structures. Complication rate was 56% overall and included transient cranial nerve deficits, CSF leaks, infection, and one death which occurred in the immediate post-operative period.

CONCLUSIONS: Pediatric skull base lesions are rare and the surgical approaches are challenging. Although good outcomes overall have been reported in the pediatric population, further work is ongoing to investigate factors that contribute most to achieving a gross total resection and minimizing post-operative morbidity in patients with pediatric skull base lesions.

176. SPINAL CORD INFARCTION FOLLOWING MINOR TRAUMA IN CHILDREN: FIBROCARTILAGINOUS EMBOLISM AS A PUTATIVE CAUSE

Matthew Frank Gary, MD; Joshua Chern, MD, PhD; Damien Grattan-Smith, MBBS; Mesyam Kebriaei, MD; Andrew Reisner, MD (Atlanta, GA)

INTRODUCTION: Spinal cord infarction following seemingly innocuous trauma in children are rare, devastating events. We present 3 cases of pediatric spinal cord infarction that followed minor trauma. An analysis of the clinical, radiographic and laboratory features of these cases suggest that embolism of the nucleus palposus into the spinal cord microcirculation is the likely mechanism. A review of human and veterinary literature supports this notion. This is the largest pediatric series of myelopathy secondary to embolism of the nucleus palposus reported to date.

METHODS: This is a retrospective single-center study which received IRB approval.

RESULTS: Three patients, aged 8 months, 8 years and 12 years of age, presented with acute cervical myelopathy following seemingly innocuous trauma. All presented with a "spinal stroke in evolution". After a variable latent period, the progression of the myelopathy was rapid over 24 hours. The degree of spinal cord injury was severe (ASIA B or C). The CSF results in all cases was negative for infectious, inflammatory or demyelinating lesions. MRI findings included progressive spinal cord enlargement, subjacent disc disease, increased spinal cord T-2 signal changes, and no contrast enhancement. All patients were treated with steroids. There was a high incidence of concurrent infections. Two patients recovered to an ASIA D, one remained an ASIA C.

CONCLUSIONS: The pathophysiology of spinal cord infarction following minor trauma remains enigmatic. Embolization of disc material to the spinal microcirculation is a putative mechanism with distinct clinical, radiographic and laboratory features that allow differentiation from other causes of acute myelopathy.

177. SPINAL DYSRAPHISM: A CHALLENGE CONTINUED TO BE FACED BY NEUROSURGEONS IN DEVELOPING COUNTRIES

Amit Agrawal, MD (Nellore, India)

INTRODUCTION: The incidence of spinal dysraphism has significantly decreased over the last few decades, all over the world; however, still the incidence in much higher in developing countries with poor socio-economic status.

METHODS: The present study includes all the patients managed for spinal dysraphism over a period of one year (January 2011-December 2011). Details of all the patients including demographics, antenatal care history, site and type of lesion, neurological examination, imaging finding, associated congenital anomalies, management offered and outcome were recorded.

RESULTS: A total 28 children were operated for spinal dysraphism during the study period (17 male and 11 female). Mean age was 14days (age range 1 day to 2190 days, median 120 days). Mothers of 15 children did not seek any regular antenatal checkup and only 13 mothers received folic acid supplementation during pregnancy. 14 children were delivered at home and 14 were at hospital. The most common site was lumbo-sacral region (67.8%). 7 patients had rupture of the sac at the time of presentation, 1 child had local infection, 4 patients had hydrocephalus (required shunt before surgical repair). The mean hospital stay was 7 days (range 5 days to 31 days, median 10 days).

CONCLUSIONS: Spinal dysraphism, is still a major public health problem in developing countries. Management of patients with spinal dysraphism is complex and needs close co-ordination between pediatrician, neurologist, neurosurgeon and rehabilitation experts and also a large number of factors influence the outcome.

178. SPORADIC MENINGIOMATOSIS AS A CAUSE OF STATUS EPILEPTICUS IN CHILDREN: A CASE REPORT

Zulma Sarah Tovar-Spinoza, MD; Yaman Eksioglu, MD, PhD; David Carter, MD; Paul Kent, MD (Syracuse, NY)

INTRODUCTION: Meningioangiomatosis is a rare benign rare condition observed sporadically or with neurofibromatosis. Sporadic cases present as medically refractory localization related epilepsy.

METHODS: A 2 year-old right-handed healthy, non-NF2, Caucasian girl presented with status epilepticus, left focal motor seizures and persistent left hemiparesis.

RESULTS: EEG and long-term video-EEG monitoring revealed seizures involving right frontal-temporal regions. Despite seizure control on levetiracetam, lacosamide, pyridoxine and clonazepam she had resistant left hemiparesis. Brain MRI revealed right frontal arachnoid cyst, adjacent cortical thickening, T2/FLAIR signal in adjacent white matter suggesting cortical dysplasia and paramedian right frontal hypoattenuation suggesting encephalomalacia. MRS showed normal NAA/ creatine and creatine/choline ratios. Due to refractory epilepsy, invasive monitoring was performed. Seizure onset was confirmed from the right frontal cortical dysplasia and the adjacent cortex. She underwent sensory/motor mapping and corticography followed by partial right frontal lobectomy. Left hemiparesis resolved immediately postsurgically. Histopathology revealed proliferation of anastomosing spindle cell strands with small central blood vessels involving cortical parenchyma. Abnormal spindle cells with fibroblastic, meningothelial appearance arose from the overlying meninges with extension into cortical parenchyma involving grey and adjacent white matter with areas of necrosis and subarachnoid hemorrhage. Patient is seizure-free since resection of the lesion.

CONCLUSIONS: Sporadic meningioangiomatosis is uncommon. MRI findings are variable and can suggest cortical dysplasia. Histopathological diagnosis is required as surgical resection can be curative in cases with refractory epilepsy.

179. SURGICAL MANAGEMENT OF INTRACRANIAL CAPILLARY HEMANGIOMAS IN CHILDREN

Paul A. Grabb, MD (Colorado Springs, CO)

INTRODUCTION: We describe the magnetic resonance imaging (MR), intraoperative findings, angiographic details, and surgical management of two children with capillary hemangiomas of the brain.

METHODS: Two children, ages fourteen and nine presented with symptoms consistent with elevated intracranial pressure. Imaging revealed well demarcated brightly enhancing lesions with considerable associated perilesional edema. Image guided craniotomies were performed.

RESULTS: Both cases were halted intraoperatively by the surgeon because of the findings of an intensely vascular lesion consistent with a possible arteriovenous malformation (AVM). Both children were taken from the operating room to the angiographic suite. Angiography was preceded by computerized tomography (CT) in the teen because of worsening intraoperative brain swelling. Angiography displayed a subtle blush in the capillary phase of one lesion, and essentially nothing in the other. The CT showed spontaneous hemorrhage medial to the lesion exacerbating the preexisting brain edema in the teen. Both children were returned promptly to the operating room and a complete excision of the lesion performed.

CONCLUSIONS: MR findings were characteristic for capillary hemangioma in retrospect. Preoperative recognition of MR findings can provide valuable assurance as to the nature of the lesion. Angiography provided assurance that the lesions were not AVMs. If confident of the MR findings angiography may not be necessary. The surgeon should be prepared to deal with significant brain swelling and spontaneous hemorrhage with these lesions.

180. SURGICAL MANAGEMENT OF PEDIATRIC EPIDURAL HEMATOMAS IN THE ERA OF TELERADIOLOGY

Julian J. Lin, MD; Ahmad Derek Martinez, MD; Brandon Bond, BA (Peoria, IL)

INTRODUCTION: The outcomes of children with surgical cranial pediatric epidural hematomas (EDH) are generally good provided that the hematomas are evacuated in a timely fashion. Teleradiology provides physicians the ability to evaluate imaging prior to patient arrival and can lead to decreased interval between arrival and evacuation, perhaps leading to improved outcome for patients.

METHODS: Retrospective review of 30 consecutive operated pediatric epidural hematomas between 2004-2012.

RESULTS: There were 22 boys and eight girls with mean age of seven years. Etiologies included sports accidents, falls, and motor vehicle collisions. Most patients presented initially to other hospitals prior to transfer. Presenting findings included GCS ranging from 8 to 15, anisicoria, vomiting, and lethargy. Seventeen of thirty (57%) patients were admitted to the ICU for observation and underwent evacuation of EDH in a delayed fashion. Ten (33%) patients went to the operating room (OR) from the emergency department (ED) for emergent evacuation while three (10%) went to the OR directly upon arrival. Teleradiology (PACS) became available in 2010 allowing access to head CTs performed at the transferring institution. In the group without PACS availability eight went to the ED then to the OR while one went directly to the OR. In the group with PACS availability two went to the ED first and two went straight to the OR. At three month follow-up 5 of 30 patients had residual deficits.

CONCLUSIONS: Teleradiology expedited the process of intervention in children with EDH and likely improved their outcomes.

181. SWELLING-PRONE VS. NON-SWELLING-PRONE INJURIES: EFFECTS OF A PATHOANATOMIC-BASED MANAGEMENT ALGORITHM

Ann-Christine Duhaime, MD; Pamela Stuart Jones, MD; Sharon Haire, NP; Rima Sestokas, BS; Sarah Murphy, MD; Elizabeth Shannon, NP; Caren Harris, NP; Alice Gervasini, PhD; Peter Masiakos, MD; George Velmahos, MD, PhD (Boston, MA)

INTRODUCTION: Triage and management decisions in patients with head injury and polytrauma can present challenges when multiple individuals and teams are involved in care. Most guidelines depend on initial Glasgow Coma Score, which can have limited specificity because of prehospital care and varying evolution of different pathoanatomic injuries. At our Level 1 Trauma Center we implemented a hospital-wide triage and management algorithm which includes grouping injuries into swelling-prone and non-swelling-prone categories, and assessed its effects on interdisciplinary communication and treatment.

METHODS: The algorithm reflects how neurosurgical decisions typically are made, based on specific features of the history, exam, and imaging, and incorporates knowledge about differences among pathoanatomic injury types with respect to risks of deterioration in the acute period. We compared a) frequency of communications issues about head injury management discussed at Multidisciplinary Trauma Case Conference, and b) radiologic imaging frequency with CT scans before and after institution of the algorithm for patients younger than 20.

RESULTS: In the surveyed period prior to institution of the algorithm, head trauma triage and management issues were included in 50% of all case quality reviews. In the post-algorithm period, this number decreased to less than 10%. Total number of CT scans obtained on comparable populations of admitted head trauma patients decreased over this interval as well.

CONCLUSIONS: Simple algorithms that incorporate pathoanatomic features, rather than just acute injury severity score, can be helpful to align expectations about management, reduce unnecessary radiation exposure, and focus on interventions targeted towards prevention of predictable complications.

182. TECTAL GLIOMAS: NATURAL HISTORY AND PROGRESSION OF THE DISEASE

Elias B. Rizk, MD; Shane Tubbs; Jerry Oakes, MD; Mark Dias, MD; James Johnston, MD; Jeffrey Blount, MD; John Wellons, MD, MSC; Curtis Rozzelle, MD (Harrisburg, PA)

INTRODUCTION: Tumors involving the tectum constitute a distinct subgroup of brain stem gliomas usually with an indolent course.

METHODS: Chart review and imaging characteristics were reviewed in patients who presented with tectal plate gliomas and progression of disease was evaluated over the follow up period at the Children's Hospital of Alabama from 1993-2012.

RESULTS: 14 number of patients were followed up for mean of 4.9 years. Tumor progression was calculated using serial MRI imaging seen in all number of patients as per radiographic evidence. Only one patient had progression of disease that required surgical resection

CONCLUSIONS: Based on our experience, tectal plate gliomas in the pediatric age group without tumor extension or contrast enhancement can be managed conservatively and followed with regular MRI scans.

183. THE INCIDENCE AND NATUAL HISTORY OF PSEUDOMENINGOCELES FOLLOWING CHIARI I DECOMPRESSION

Vikram Chakravarthy; Usiakimi Igbaseimokumo, MD; Doug Rivard, DO (Kansas City, MO)

INTRODUCTION: Chiari decompression is often asscociated with cerebrospinal fluid related complications. The incidence and natural history is variable due to the lack of common definitions. A single institution experience of CSF related morbidity following Chiari decompression is described to determine true incidence and natural history.

METHODS: A retrospective cohort analysis of a consecutive series of patients treated over five years (2007-2011) with MRi definition of incidence and natural history. Univariate analysis of demographic data including BMI and logistic regression (SPSS) was used to determine the predictors of pseudomeningoceles and its natural history.

RESULTS: In all 38 patients were eligible for the study during the five year period and the mean age was 7 years (range 1-15 years) with 21 females. The incidence of pseudomeningocele on MRi was 37% but only two CSF leak (5.3%). Most (50%) pseudomeningoceles resolved spontaneously at up to 2 years but reoperation for all reasons was 20% (8 patients). Time since surgery and the BMI were significantly associated with the prevalence of pseudomeningocele. There were no associations with surgical technique including the use of allogenic grafts.

CONCLUSIONS: The incidence of pseudomeningocele is high following Chiari I decompression and there is a need to standardize both the MRI definition and post operative follow-up to confirm what factors are predictive of need for re-operation.

184. THE ROLE OF ANEURYSM SYBTYPE IN THE LONG TERM NEUROLOGICAL OUTCOME OF PEDIATRIC ANEURYSM-ASSOCIATED AVM PATIENTS

Christopher Paul Kellner, MD; Michael McDowell, BS; Kevin Naranjo, BS; Eric Sussman, BS; Rachel Bruce, BA; Sam Bruce, MS; Simon Heuts, BS; Richard Anderson, MD (New York, NY)

INTRODUCTION: There is much debate about the role that aneurysms play in the risk of intracerebral hemorrhage (ICH) when associated with Arteriovenous Malformations (AVMs) in the pediatric population. Preliminary cohorts have suggested that concurrence does not increase the risk of hemorrhage or predict long-term outcomes. However, these studies rarely differentiated by aneurysm type. We sought to assess the risk of hemorrhage and poor outcome when aneurysms were separated into arterial and non-arterial subtypes.

METHODS: Twenty-four patients with aneurysm-associated AVMs were treated at the Columbia University Medical Center between 1991 and 2011. Medical records and imaging studies were retrospectively reviewed and separated by aneurysm sub-type. Clinical outcome based on the modified Rankin Scale (mRS) and risk of ICH were compared between the two subtypes.

RESULTS: Of the 24 patients, 11 had arterial aneurysms (45.8%) and 13 had non-arterial aneurysms (54.2%). Ten patients with arterial aneurysms presented with ICH. Four patients with non-arterial aneurysms (30.8%) presented with ICH ($p < 0.01$). The mean mRS on admission was 2.55 and 0.54 on follow up for the arterial group. The mean mRS on admission was 1.54 and 1.27 on follow up for the non-arterial group. Follow up mRS was not significantly different ($p=0.102$).

CONCLUSIONS: AVM-associated aneurysms of an arterial nature may be more likely to present with hemorrhage, but may not predict a worse outcome than those with only non-arterial aneurysms. This may be due to the low power of the study, a predominantly AVM-associated risk of hemorrhage, or aggressive management of patients with AVM-associated aneurysms.

185. THE CERVICAL SPINE IN KLIPPEL-FEIL SYNDROME: A NATURAL HISTORY STUDY

Elias B. Rizk, MD; Shane Tubbs, PhD; Jerry Oakes, MD; Curtis Rozzelle, MD; Jeffrey Blount, MD; John Wellons, MD; Josh Menendez, MD; James Johnston (Harrisburg, PA)

INTRODUCTION: Klippel-Feil syndrome may be associated with hypermobility of the cervical spine between the fused segments.

METHODS: A chart review was performed on all patients seen and evaluated at the Children's Hospital of Alabama between 1993 and 2012. Asymptomatic patients with cervical spine instability were chosen and an average follow up period was calculated.

RESULTS: 52 patients were identified from the databank with the diagnosis of Klippel-Feil syndrome. 25 patients were identified with adequate flexion extension films. Imaging showed evidence of adjacent level hypermobility in 23 patients. None of the identified patients underwent prophylactic cervical immobilization. None of the patients developed worsening neurologic signs or symptoms over the course of the follow up.

CONCLUSIONS: Based on our experience, non-operative management and expectant observation is a reasonable option in patients with Klippel-Feil syndrome and cervical instability without neurologic involvement.

186. TIME TO FAILURE FOR FIRST-TIME SHUNTS IN CHILDREN AGED FIVE YEARS AND OLDER

Kevin Carr; Ato Wallace, BS; Luke Tomycz, MD; Noel Tulipan, MD (Nashville, TN)

INTRODUCTION: The one-year failure rate for newly inserted ventriculoperitoneal shunts in the pediatric population has been reported in numerous series to be as high as 40%. Age at time of shunt insertion has been shown to be a significant factor in shunt survival.

METHODS: Using CPT codes and billing records, we identified all the patients who underwent ventriculoperitoneal shunting at Vanderbilt Children's Hospital between 1997 and 2012. We excluded all children who were under age five at the time of first shunt insertion. We then reviewed the Starpanel™ electronic chart system to determine the indication for shunting, the percentage of shunts that failed, the mean average time to failure, and the total follow-up time.

RESULTS: A total of 121 patients were included with an average age of 11.67 years (SD = 4.01). Indications for shunt insertion included idiopathic intracranial hypertension (20.7%), tumor (49.6%), and hemorrhage (11.6%), among other causes. Overall 26.4% of the cohort experienced shunt failure with a mean time to failure of 437.27 days and an average total follow-up of 711 days. Of the 16 patients who developed failures, 10 were due to infection, 1 due to overdrainage and the rest were due to mechanical obstruction of either the proximal catheter, distal catheter, or valve.

CONCLUSIONS: First-time shunt insertion in children five years of age or older is associated with a relatively low failure rate at two years.

187. TRANSTENTORIAL STENT INSERTION IN THE MANAGEMENT OF ISOLATED FOURTH VENTRICLE

Jothy Kandasamy, MD; Russell Frood; Jerard Ross, MD; Muhammad Dherijha, MD (Leeds, United Kingdom)

INTRODUCTION: Isolated fourth ventricle is an uncommon condition. There are several techniques described for its management. These methods are associated with various benefits and complications. This presentation illustrates the use of transtentorial stenting as an option for the management of this condition.

METHODS: A retrospective case series study of patients who had a transtentorial stent placed at the Royal Hospital for Sick Children, Edinburgh between 2011 and 2012. Patient' notes, surgical database and radiological imaging were reviewed. There were three patients who underwent this procedure; one patient requiring the procedure twice leading to the four cases presented.

RESULTS: None of the patients suffered from perioperative / immediate postoperative complications. One patient required their stent to be removed and then later replaced due to a delayed presentation of shunt infection. All patients had a reduction in their fourth ventricle size demonstrated radiologically with MRI or CT and commensurate clinical improvement.

CONCLUSIONS: This case series highlights the viability of transtentorial stenting as a safe and effective management option for selected cases of isolated fourth ventricle.

188. VERTEBRAL CHORISTOMA IN LIPOMYELOMENINGOCOELE – CASE REPORT

Shejoy P. Joshua, MD; Pankaj Singh, MD; Ashok Mahapatra, MD (New Delhi, India)

INTRODUCTION: Lipomeningocoele is a type of occult spinal dysraphism characterised by a subcutaneous lipomatous mass that protrudes through a midline bony defect. We report rare presentation of this condition- a vertebral choristoma wherein the lipomatous mass displaced the normally formed posterior elements- lamina and spinous process of L4 vertebra dorsally to an abnormal location in the absence of a bony defect.

METHODS: A five year old girl, presented to us with a bony hard swelling in the lower lumbar area, since birth. A Lumbo-sacral MRI showed was a lipomatous mass extending from the conus to the subcutaneous space with the spinal cord tethered, conus ending at L5. There was another mass of the shape of the lamina and spinous process at expected level of posterior elements of L4 vertebra, which was isointense on T1 and placed around 2 cm dorsal compared to the posterior elements L3 and L5.

RESULTS: Lipomyelomeningocoele is a rare congenital condition which may be associated with vertebral anomalies.

CONCLUSIONS: This paper reiterates our knowledge of the embryologic development of the spinal cord and proves the plasticity of the growing spine to malformative forces.

189. VIDEO DIVERSION DURING FUNDOSCOPIC EXAM IN CHILDREN: A RANDOMIZED CONTROLLED TRIAL

Ashutosh Singhal, MD, FAANS, FRCSC; Michael Yang, MS; John Kerr, BS (Vancouver, Canada)

INTRODUCTION: Fundoscopy is an important aspect of the neurological examination, but can be challenging in uncooperative children. This study explored whether viewing a video (selected by patient or caregiver) during eye examination improves the success, duration and ease of pediatric fundoscopy.

METHODS: A single-practitioner, block-randomized study was conducted at the BC Children's Hospital Pediatric Neurosurgery outpatient clinic. Sixty patients, 1-8 years old, were randomized (by eye examined) to treatment group (video-assisted fundoscopy) or control (non-video fundoscopy). Successful exams were defined as visualizing the optic disk within 60s. Both caregivers and practitioner ranked the level of difficulty of each exam (10-point Likert scale).

RESULTS: 33 female and 27 male subjects were enrolled, with a median age of 3.7 years. There was a 28% absolute improvement in the success rate of visualizing the optic disk (video - 90% success vs. non-video 62%, p<0.001). Further analysis showed a 48% absolute improvement in success rate in children 1-4 years of age (p<0.001), but no difference in children 5-8 years old (p=0.23). Time needed to visualize the optic disk also improved (Δ16.3s, p<0.001). An improvement in ease of examination (p<0.001) was noted by both examiner and caregiver.

CONCLUSIONS: Videos were successful at improving the ease, time, and most importantly, success of fundoscopy in children. There was no effect on success rate in older children, but time and perceived difficulty improved. This simple, inexpensive adjunct to the ophthalmological assessment has great potential to improve the ease and efficacy of this aspect of the pediatric neurological examination.

190. WORSENING OR DEVELOPMENT OF SYRINGOMYELIA FOLLOWING CHIARI I DECOMPRESSION

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INTRODUCTION: The effects of posterior fossa decompression on Chiari induced syringomyelia have been well described. However, treatment of worsening syringomyelia after Chiari decompression remains enigmatic.

METHODS: A retrospective review of patients at the Children's Hospital of Pittsburgh and Children's of Alabama who developed worsening syringomyelia after Chiari decompression was performed.

RESULTS: Fourteen children (age range 8 months to 15 years), half of whom had preoperative syringomyelia, underwent posterior fossa decompression. Aseptic meningitis (n=3) and bacterial meningitis (n=2) complicated 5 cases (4 were originally treated at outside hospitals). Worsening syringomyelia presented a median of 1.4 years (range 0.3-10.3 years) after the primary decompression. Ten children presented with new, recurrent, or persistent symptoms, and 4 were asymptomatic. Secondary Chiari decompression was performed on 11 of the 14 children. The other 3 were advised to undergo secondary decompression. A structural cause for each failed primary Chiari decompression was identified (e.g., extensive scarring, suture in the obex, arachnoid web, residual posterior arch of C1, no duraplasty). After secondary decompression 8 patients' symptoms completely resolved, one patient stabilized, and two patients remained asymptomatic. Radiologically, syrinx size decreased in 10 of 11 children. Median follow-up from initial Chiari decompression was 3.1 years (range 0.8-14.1) and from secondary decompression, 1.3 years (range 0.3-4.5). No patient underwent a syringopleural shunt or other non-posterior fossa treatment for syringomyelia.

CONCLUSIONS: Based on our experience, children with worsening syringomyelia after Chiari I decompression should be treated with secondary decompressions.

191. YOUTUBE AND HYDROCEPHALUS: CONTENT QUALITY, RELIABILITY, AND COMPREHENSIVENESS

Robert Partlow Naftel, MD; Jeffrey Blount, MD (Pittsburgh, PA)

INTRODUCTION: Increasingly, caregivers and patients rely on the Internet and social media for medical information. YouTube is the most widely utilized Internet audiovisual interface. This study examines the quality, reliability, and comprehensiveness of hydrocephalus-related YouTube videos.

METHODS: YouTube was searched for the keyword hydrocephalus. The first 176 videos (10 pages) were judged independently by 2 neurosurgeons and categorized as useful (scientifically correct information), misleading (unproven or inaccurate), or personal experiences/patient views (testimonials, awareness, support). On 5-point scales, all videos were scored for content quality (QS), and useful videos were scored for reliability (RS) and comprehensiveness (CS).

RESULTS: Of 176 videos watched, 62 were eliminated due to exclusion criteria. The majority of videos were produced by independent users (61/114), physicians/universities (18/114), professional societies (20/114), and the remainder by government agencies, news agencies, pharmaceutical/device companies, or health websites. Videos primarily targeted pediatric hydrocephalus (107/114) and were intended for lay audiences (108/114). Of 114 videos, 53 were useful educational videos (QS 2.7 +/- 0.8), 9 were misleading (QS 1.9 +/- 0.6), and 52 were personal experiences (QS 1.9 +/- 0.5). Useful videos were moderately comprehensive (CS 2.4 +/- 1.4) but not very reliable (RS 1.7 +/- 1.2). All personal experience videos reflected positively and either provided emotional support or disease awareness.

CONCLUSIONS: Nearly half of hydrocephalus-related YouTube videos were useful, educational videos and very few were misleading; however, overall quality, reliability, and comprehensiveness were low. The other portion of videos provided emotional support and increased disease awareness through testimonials and videos of solidarity.

192. ANTI-CD47 THERAPY AS A COMMON THERAPEUTIC TARGET FOR PEDIATRIC BRAIN TUMORS

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INTRODUCTION: A characteristic feature of tumor progression and recurrence is its ability to evade the immune system. Our hypothesis is that by modulating the innate immune system we can enhance the ability of macrophages to 'eat and kill' brain cancer cells. Recent data suggests that the interaction between the cell surface antigen CD47 and its binding partner Sirp-alpha is a mechanism by which non-solid and solid tumors can evade the innate immune system.

METHODS: To see if anti-CD47 therapy is a potential therapy in malignant pediatric brain tumors we first looked at CD47 expression in freshly isolated patient and postmortem samples from 4 different tumor types; Diffused Intrinsic Pontine Glioma, Medulloblastoma, Ependymoma and ATRTs. We next established orthotopic xenografts models in immune compromised mice and treated them with anti-CD47 humanized antibody, which is currently being developed for clinical trials in hematopoietic and non-CNS malignancies.

RESULTS: CD47 expression was upregulated in all tumor types and was present in <90% of the cells in high grade tumor. Increased CD47 expression was observed in CD15+ and CD133+ putative cancer stem cell population. Blocking the CD47-Sirp-alpha interaction increases tumor phagocytosis by macrophages in-vitro. Systemic treatment with anti-CD47 antibody significantly reduced tumor burden in an orthotopic xenograft model.

CONCLUSIONS: Anti-CD47 antibody has potent anti-tummor effects in our preclinical models of pediatric brain tumors.

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