42 ANNUAL MEETING

of the AANS | CNS Section on Pediatric Neurological Surgery

December 3-6, 2013
Westin Harbour Castle
Toronto, ON, Canada

Embracing our past...leading our future.

PROGRAM BOOK >

Jointly Sponsored by the AANS

American Association of Neurological Surgeons
and the American Association of Neurosurgeons

Congress of Neurological Surgeons

WELCOME

NEW MEETING APP AVAILABLE!

Download the annual meeting app and enhance your meeting experience! This free, web-based, easy-to-use tool is available to attendees by visiting www.pedsneurosurgery.org. You can download to any mobile device and review abstracts, create your own schedule, preview exhibitor information and more.

Plus, contribute to the real-time discussions and happenings in Toronto by using the official meeting hashtag—#PedsNeuro13—on all your Tweets. Be a part of the conversation! – #PedsNeuro13.

FUTURE MEETING SITE

2014 Amelia Island, Florida
December 2-5, 2014

Previous Annual Meeting Sites

1972	Cincinnati	1995	Pasadena
1973	Columbus	1996	Charleston
1974	Los Angeles	1997	New Orleans
1975	Philadelphia	1998	Indianapolis
1979	New York	1999	Atlanta
1980	New York	2000	San Diego
1981	Dallas	2001	New York
1982	San Francisco	2002	Scottsdale
1983	Toronto	2003	Salt Lake City
1984	Salt Lake City	2004	San Francisco
1985	Houston	2005	Orlando
1986	Pittsburgh	2006	Denver
1987	Chicago	2007	South Beach (Miami)
1988	Scottsdale	2008	Spokane
1989	District of Columbia	2009	Boston
1990	San Diego/Pebble Beach	2010	Cleveland
1991	Boston	2011	Austin
1992	Vancouver, BC	2012	St. Louis
1993	San Antonio	2013	Toronto
1994	St. Louis		

TABLE OF CONTENTS

Annual Meeting Sites 2
Accreditation/Designation 3
Officers and Standing Committees of the AANS/CNS Section on Pediatric Neurological Surgery 4-5
2013 Raimondi Lecture 6
AAP/Section on Neurological Surgeons (SONS) Speaker 6
Lecturers 7
Matson Memorial Lecturers 7
Franc Ingraham Award for Distinguished Service and Achievement Recipients 7
Kenneth Shulman Award Recipients 8
Hydrocephalus Association Award Recipients 9
Meeting Room Floor Plan 10
Exhibit Hall Floor Plan 11
Exhibitor Listing 12-14
Educational Grants 15
Program At-A-Glance 16
Disclosure Information 17-18
Mid-Level Practitioner's Seminar 19-20
Annual Meeting Program 21-29
Scientific Program Oral Abstracts 30-48
Scientific Program E-Poster Abstracts 49-83
Section Membership Roster 84-94

ACCREDITATION | DESIGNATION

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 25.5 *AMA PRA Category 1 Credits™*. Physicians should claim only the credit commensurate with the extent of their participation in the activity.

This continuing nursing education activity was approved by the American Association of Neuroscience Nurses, an accredited approver by the American Nurses Credentialing Center's Commission on Accreditation.

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ANNUAL MEETING LEARNING OBJECTIVES

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

- Explain current controversies in pediatric neurosurgery;
- Recognize opportunities for surgeons as leaders in hospitals and society;
- Appreciate the spectrum of pediatric neurosurgical research currently conducted in North America; and
- Review management of pediatric neurosurgical conditions.

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 [email 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 Clinic, Breakfast Seminars or Mid-Level Practitioner's Seminar. By turning in your ticket onsite, 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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1972-73	Robert L. McLaurin
1973-74	M. Peter Sayers
1974-75	Frank Anderson
1975-76	Kenneth Shulman
1976-77	E. Bruce Hendrick
1977-78	Frank Nulsen
1978-79	Luis Schut
1979-81	Fred J. Epstein
1981-83	Joan L. Venes
1983-85	Harold J. Hoffman
1985-87	William R. Cheek
1987-89	David G. McLone
1989-91	Donald H. Reigel
1991-93	R. Michael Scott
1993-95	Arthur Marlin
1995-97	Harold L. Rekate
1997-99	Marion L. Walker
1999-01	John P. Laurent
2001-03	Thomas G. Luerssen
2003-05	Andrew D. Parent
2005-07	Rick Abbott
2007-09	Jeffrey H. Wisoff
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2011-13	Alan R. Cohen
2013-15	Bruce A. Kaufman

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Jeffrey R. Leonard, MD, FAANS; Matthew D. Smyth, MD, FAANS, Co-chairs Past Meeting (2012, St. Louis)

Philipp R. Aldana, MD, FAANS, Future Meeting (2014 Jacksonville/Amelia Island)

Bruce A. Kaufman, MD, FAANS, Ex-Officio-Section Chair

Mark D. Krieger, MD, FAANS, Ex-Officio-Section Treasurer

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Catherine A. Mazzola, MD, FAANS, Co-chair (2013-2015)

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Nicholas M. Wetjen, MD, FAANS (2013-2015)
Todd C. Hankinson, MD, MBA, FAANS (2013-2015)
Samuel R. Browd, MD. PhD, FAANS (2013-2015)

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Sanjiv Bhatia, MD, FAANS (2010-2015)
David I. Sandberg, MD, FAANS (2010-2015)

International Education Subcommittee
Jogi V. Pattisapu, MD, FAANS(L) (2010-2015)

Examination Questions Committee
Cormac O. Maher, MD, FAANS (2013-2015)

Lifetime Achievement Award
Alan R. Cohen, MD, FAANS (2013-2015)

Transition of Care Committee
Vacant

Research Committee
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John R.W. Kestle, MD, FAANS
Ann-Christine Duhaime, MD, FAANS
Edward R. Smith, MD, FAANS

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Liaison to the Washington Committee, AANS/CNS
Alan R. Cohen, MD, FAANS (2013-2015)

Liaison to the Washington Communications Committee on Public Relations
Non-active

Pediatric Section Representatives on the Joint Guidelines Committee
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Lissa C. Baird, MD (2013-2015)

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Matthew D. Smyth, MD, FAANS (2008)

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Tae Sung Park, MD, FAANS (2010)

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Liaison with ISPN
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Liaison with ASPN
Alan R. Cohen, MD, FAANS (2012-2014)

Liaison with AAP Section on Neurological Surgery (SONS)
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David P. Gruber, MD, FAANS (2010)

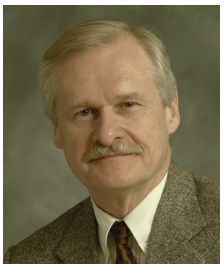
Liaison to the Devices and Technology Committee, AANS
Shenandoah Robinson, MD, FAANS (2008)

Liaison to the Young Neurosurgeons Committee
Suresh N. Magge, MD (2012)

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

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

KEYNOTE SPEAKERS



2013 RAIMONDI LECTURE

Bryce R. Taylor, MD

Bryce Taylor, MD, is a professor of surgery at the University of Toronto and the medical director of the University Health Network's International Patients Program. Dr. Taylor has led an accomplished career, having held numerous leadership positions. Among his many roles, for 11 years, he served as James Wallace McCutcheon Chair, surgeon-in-chief and director of surgical services of the University Health Network, comprising the Toronto General Hospital, Toronto Western Hospital and Princess Margaret Hospital. He also has served as president of the Canadian Association of General Surgeons, and has been the recipient of multiple teaching awards. His clinical interests include hepatobiliary and pancreatic surgery, transplantation and endoscopy. He was a member of the team that initiated the University of Toronto Liver Transplantation Program, and remains active in the training of residents and fellows at all levels in general surgery. Author of the book, "Effective Medical Leadership," Dr. Taylor also has published more than 110 papers in peer-reviewed journals. He continues to consult on such issues as information technology in surgery and operational aspects of surgical care.

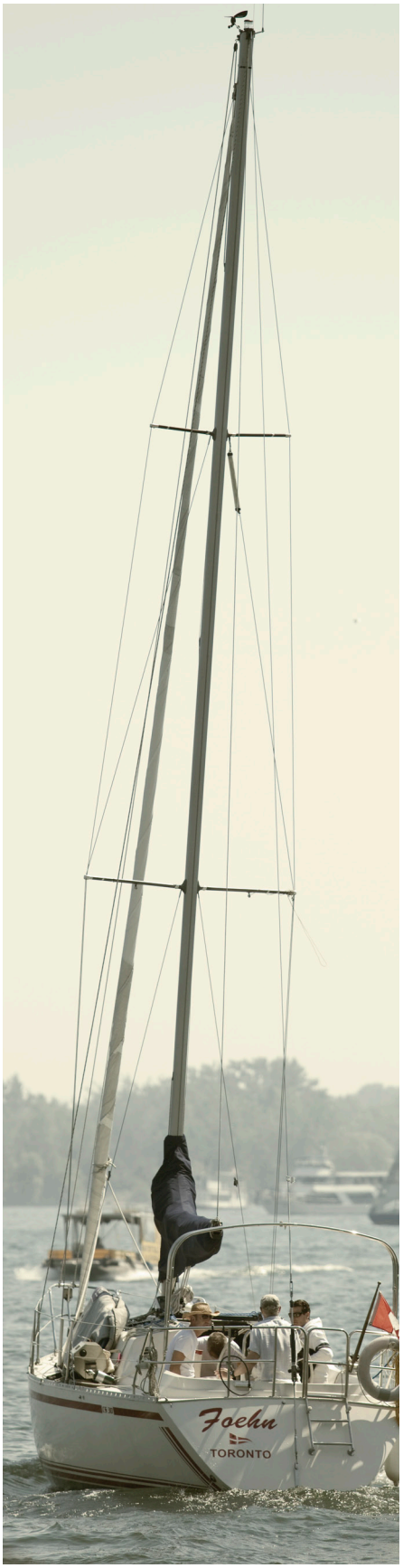
A book signing by Dr. Taylor will be available in the Exhibit Hall immediately following his presentation.

2013 AAP/SECTION ON NEUROLOGICAL SURGERY (SONS) SPECIAL LECTURE

Steven Miller, MDCM, FRCPC

Steven Miller, MDCM, FRCPC is head of the division of neurology and staff neonatologist at the Hospital for Sick Children, Toronto, where he also is senior scientist in neurosciences and mental health at its Research Institute. Professor in the department of paediatrics at the University of Toronto, Dr. Miller is the Holland Bloorview Kids Rehabilitation Hospital Foundation Chair in Paediatric Neuroscience. Collaborating with a multidisciplinary team, his research program focuses on better understanding brain injury and development in the newborn. He and his team use advanced brain imaging and detailed long-term follow-up to help children who were born early or with conditions that put them at risk of neurological and developmental deficits. Dr. Miller has contributed to our understanding of brain abnormalities caused directly by premature birth, perinatal asphyxia or indirectly by congenital heart disease.

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
2013 Bryce R. Taylor

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
2013 Joseph Volpe

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

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

2012 **Caitlin E. Hoffman**
Role of Bone Marrow Derived Cells in the Tumor Microenvironment of Medulloblastoma

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 Postoperative DTI parametes in Young Hydrocephalic Children

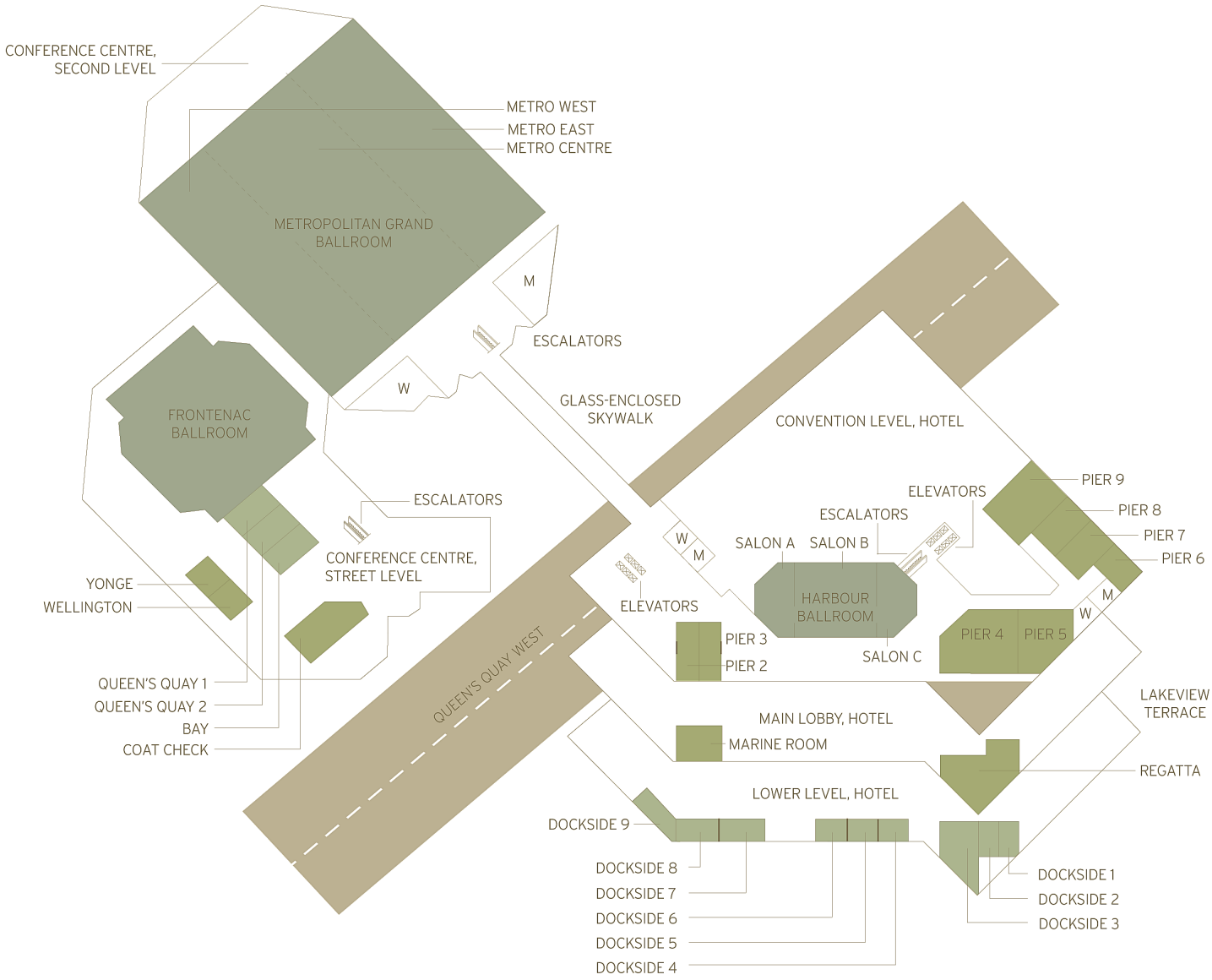
2009 **Christopher Janson**
Immortalization and Functional Characterization of Rat Arachnoid Cells

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

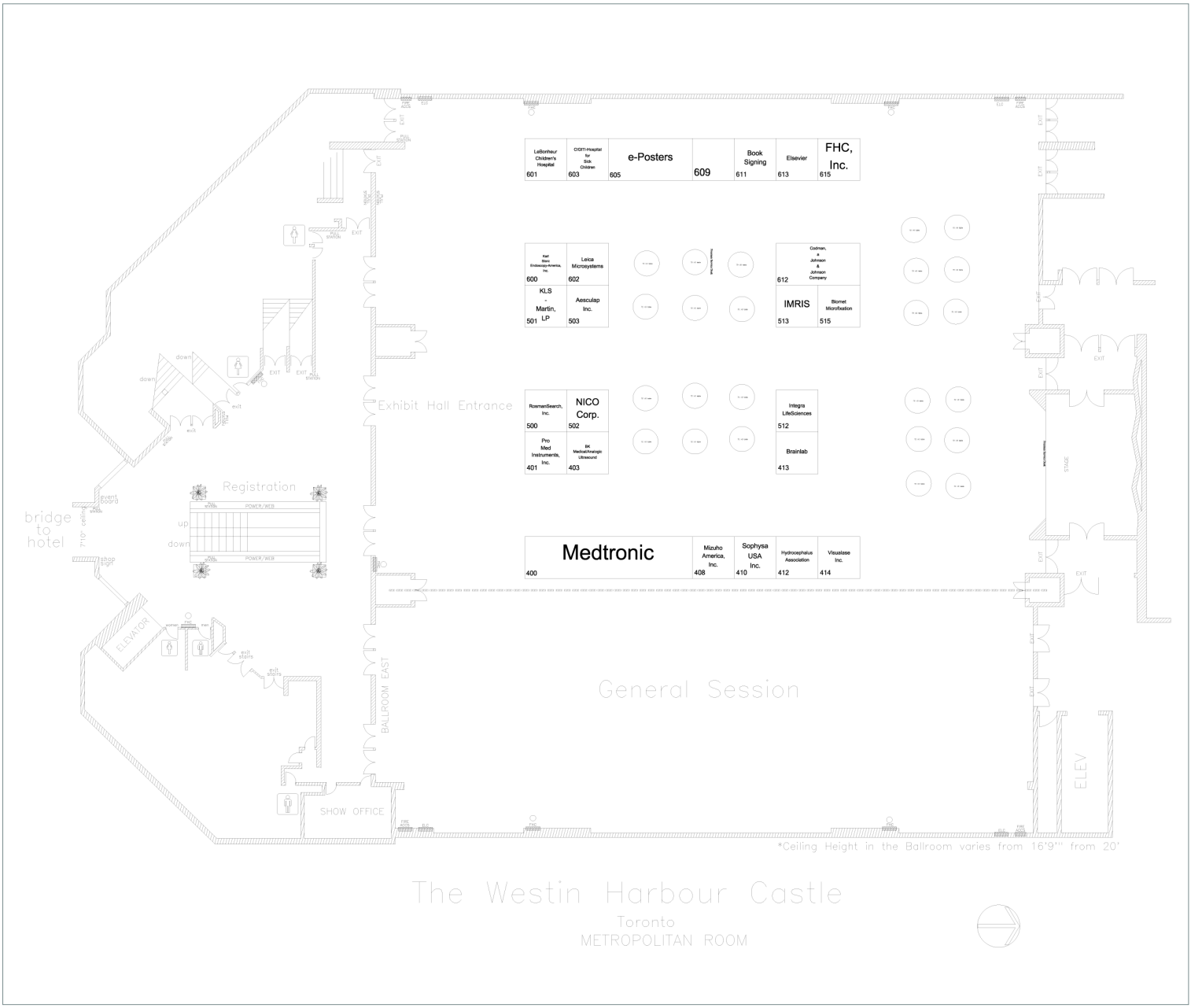
2012 **Jayant Prasanna Menon**
Significant Shunt Obstruction Casused by Parenchymal Tissue Shearing During Ventricular Catheter Implantation

MEETING ROOM FLOOR PLAN



THE WESTIN HARBOUR CASTLE

EXHIBIT HALL FLOOR PLAN



EXHIBITOR LISTING [AS OF NOV. 11, 2013]

The AANS/CNS Section on Pediatric Neurological Surgery gratefully recognizes the support of the following exhibitors:

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Phone: 888.598.3789
www.hydroassoc.org
Booth 412

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 600

KARL STORZ Endoscopy-America, Inc., a leader in diagnostic and operative endoscopic technologies, designs, engineers, manufactures and markets products emphasizing visionary design, precision craftsmanship and clinical effectiveness. KARL STORZ offers products for every surgical specialty. These include FULL solutions for minimally invasive neurosurgery, from instrumentation and HD imaging to OR integration.

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Jacksonville, FL 32245-6369
Phone: 904.641.7746
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LeBonheur Children's Hospital
50 North Dunlap Street
Memphis, TN 38103-2800
Phone: 866.705.8729
http://lebonheur.org/our-services/neuroscience-institute/
Booth 601

The Neuroscience Institute at Le Bonheur Children's Hospital in Memphis, TN is one of the nation's best pediatric neuroscience programs. Highly ranked by U.S. News & World Report, Le Bonheur's program has the most advanced technology, clinical expertise and state-of-the-art facilities.

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Phone: 800.526.0355
www.leica-microsystems.com
Booth 602

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Medtronic
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2600 Sofamor Danek Drive
Minneapolis, MN 55432
Phone: 800.876.3133
www.medtronic.com
Booth 400

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 #400 to learn more.

EXHIBITOR LISTING [AS OF NOV. 11, 2013]

Mizuho America, Inc.
30057 Ahern Avenue
Union City, CA 94587
Phone: 800.699.2547
www.mizuho.com
Booth 408

Mizuho America, Inc. is a cerebrovascular focused instrumentation company whose main products include Sugita T2 Aneurysm Clips, 7201B Operating Table, Cranial Stabilization Systems, Micro lnstruments, Kelly Endonasal Set, Lawton Neurovascular Bypass Set, Evans Rotatable Set, Day-Bailes Suction Tubes, and lntracranial & Vascular Dopplers. When it's Microsurgery, it's Mizuho.

NICO Corp.
250 East 96th Street
Suite 125
Indianapolis, IN 46240
Phone: 888.632.7071
www.niconeuro.com
Booth 502

NICO Corporation is progressing minimally invasive corridor neurosurgery by creating instruments that allow for access through smaller openings and resection of soft tissue abnormalities in the central nervous system.

Pro Med Instruments, Inc.
4529 SE 16th Place
Suite 101
Cape Coral, FL 33904-7444
Phone: 239.369.2310
www.headrest.de
Booth 401

PMI designs and manufactures the largest selection of cranial stabilization and brain retractor systems for neurosurgery, including the DORO® Multipurpose Skull Clamp, designed for pediatric applications, including infants. 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: DORO® Skull Clamps with Quick-Rail™ Technology, autoclavable Headrest Systems and FDA-cleared MRI-safe Radiolucent Headrest System. World's First Adjustable NON-STICK Bipolar Forceps.

RosmanSearch, Inc.
30799 Pinetree Road
#250
Pepper Pike, OH 44124-5903
Phone: 216.256.9020
www.rosmansearch.com
Booth 500

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

Sophysa USA Inc.
303 South Main Street
Crown Point, IN 46307-4023
Phone: 219.663.7711
www.sophysa.com
Booth 410

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.

Visualase Inc.
8058 El Rio Street
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Phone: 713.275.2063
www.visualaseinc.com
Booth 414

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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

TUESDAY, DEC. 3

TIME	EVENT	LOCATION
6:45 a.m.-7 p.m.	Registration	Metropolitan Ballroom Foyer - *Conference Center, Second Level*
8 a.m.-4:30 p.m.	Mid-Level Practitioner's Seminar	Harbour Ballroom AB - *Hotel, Convention Level*
8:30 a.m.-4:30 p.m.	Pediatric Epilepsy Surgery - Practical Clinic	Toronto Surgical Skills Centre - *Mount Sinai Hospital*
6-7:30 p.m.	Opening Reception	Pier 4 and 5 - *Hotel, Convention Level*

WEDNESDAY, DEC. 4

6:15 a.m.-5 p.m.	Registration	Metropolitan Ballroom Foyer
6:45-7:45 a.m.	Breakfast Seminar	Queen's Quay - *Conference Center, Street Level*
7:15-7:55 a.m.	Continental Breakfast in the Exhibit Hall	Metropolitan Ballroom West/Centre *Conference Center, Second Level*
7 a.m.-5:30 p.m.	Exhibit Hall Open and e-Poster Viewing	Metropolitan Ballroom West/Centre
7:55 a.m.-12 p.m.	Plenary and Scientific Sessions	Metropolitan Ballroom East *Conference Center, Second Level*
10-10:30 a.m.	Beverage Break in the Exhibit Hall	Metropolitan Ballroom West/Centre
12-1 p.m.	Lunch in the Exhibit Hall and Book Signing	Metropolitan Ballroom West/Centre
1-4:30 p.m.	Scientific Sessions	Metropolitan Ballroom East
2:40-3:10 p.m.	Beverage Break in the Exhibit Hall	Metropolitan Ballroom West/Centre
4:30-5:30 p.m.	Wine and Cheese Reception in the Exhibit Hall	Metropolitan Ballroom West/Centre

THURSDAY, DEC. 5

6:15 a.m.-5 p.m.	Registration	Metropolitan Ballroom Foyer
6:30-7:30 a.m.	Inaugural 5K Polar Bear Classic Run	Harborside - Starting Location-Outside Westin
6:45-7:45 a.m.	Breakfast Seminar	Queen's Quay
7:15-8 a.m.	Continental Breakfast in the Exhibit Hall	Metropolitan Ballroom West/Centre
7 a.m.-3 p.m.	Exhibit Hall Open and e-Poster Viewing	Metropolitan Ballroom West/Centre
8 a.m.-12 p.m.	Plenary and Scientific Sessions	Metropolitan Ballroom East
9:45-10:15 a.m.	Beverage Break in the Exhibit Hall	Metropolitan Ballroom West/Centre
12-1 p.m.	Lunch in the Exhibit Hall	Metropolitan Ballroom West/Centre
1-4:30 p.m.	Scientific Sessions	Metropolitan Ballroom East
2:30-3 p.m.	Beverage Break in the Exhibit Hall	Metropolitan Ballroom West/Centre
4:30-4:45 p.m.	Annual Business Meeting	Metropolitan Ballroom East
6-10 p.m.	Special Evening Event	Hockey Hall of Fame

FRIDAY, DEC. 6

6:15-11 a.m.	Registration	Metropolitan Ballroom Foyer
6:45-7:45 a.m.	Residents and Medical Students Meet the Leadership Breakfast	Pier 2 and 3 - *Hotel, Convention Level*
7:15-8 a.m.	Continental Breakfast in the Exhibit Hall	Metropolitan Ballroom West/Centre
7-10:15 a.m.	Exhibit Hall Open and e-Poster Viewing	Metropolitan Ballroom West/Centre
8-11:25 a.m.	Plenary and Scientific Sessions	Metropolitan Ballroom East
9:45-10:15 a.m.	Beverage Break in the Exhibit Hall	Metropolitan Ballroom West/Centre

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 that 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.

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MID-LEVEL PRACTITIONER'S SEMINAR AGENDA

TUESDAY, DEC. 3

8 a.m.-4:30 p.m.
Harbour Ballroom AB-Hotel, Convention Level

The goal of the Mid-Level Practitioner's Seminar is to enhance the technical skills and knowledge of the pediatric neurosurgery mid-level practitioner. This pre-meeting seminar will include presentations from a number of invited speakers addressing ethical dilemmas and a variety of management strategies for concussions, Chiari malformation, fluid balance and pediatric spine injuries. New this year, four small-group breakout sessions address suturing, shunt programmers, tapping of shunt, and pump interrogation and programming will be offered to provide a hands-on component.

Learning Objectives:

- Formulate a framework to approach ethical dilemmas commonly encountered by mid-level practitioners in pediatric neurosurgery
- Describe the current literature supporting the use of various shunt valves
- Compare and contrast various shunt valves
- Interpret presenting signs/symptoms of Chiari malformations
- Distinguish different treatment options for Chiari malformations
- Discriminate the criteria involved in selecting patients for epilepsy surgery
- Explain outcomes of common epilepsy procedures
- Analyze the role of sodium fluid in the pediatric neurosurgical patient
- Recognize the potential for Deep Brain Stimulation in the pediatric population
- Explain the current return to play guidelines following mild TBI in youth
- Differentiate indications for tapping a shunt
- Demonstrate a patient exam and shunt-tapping procedures
- Demonstrate the programming programmable valves
- Demonstrate titration and refills of Intrathecal Baclofen Pump
- Apply Intrathecal Baclofen Pump programming
- Select appropriate sutures and perform instrument and hand ties
- Discuss the treatment options of endoscopic strip craniectomy and postoperative helmet therapy for craniosynostosis
- Explain different applications and information gained from CT and MRI of the cervical spine
- Assess the indications for application of the variety of spinal orthoses
- Identify inconsistencies regarding halo pin site care protocols
- Discuss various halo pin techniques

MID-LEVEL PRACTITIONER'S SEMINAR

8-8:15 a.m.
Welcome and Introductions
Abhaya V. Kulkarni, MD, FAANS

8:15-8:45 a.m.
Epilepsy Surgery
Mandeep S. Tamber, MD, PhD, FAANS

8:45-9:15 a.m.
How to Choose a Shunt Valve
Jay K. Riva-Cambrin, MD, FAANS

9:15-9:45 a.m.
Chiari: Diagnosis and Management
Kurtis I. Auguste, MD, FAANS

9:45-10 a.m.
Beverage Break

10-10:30 a.m.
Ethical Dilemmas for Mid-Level Practitioners
Patrick J. McDonald, MD, MHSc

10:30-11 a.m.
Sodium and Fluid in the Neurosurgical Patient
Anne-Marie Guerguerian, MD, PhD

11-11:30 a.m.
Deep Brain Stimulation
Scellig S. Stone, MD, PhD

11:30 a.m.-12 p.m.
Mild Head Injury/Concussion: Return to School/Return to Play
Katia Sinopoli, PhD

12-1 p.m.
Lunch
Harbour Ballroom C-Hotel, Convention Level

1-1:25 p.m.
Concurrent Breakouts

- **Tapping of Shunt**
  Pier 5-Hotel, Convention Level
  Donna Wallace, NP
- **Use of Shunt Programmers**
  Pier 3-Hotel, Convention Level
  Cathy Cartwright, NP
- **Baclofen Pump Interrogation/Programming**
  Pier 2-Hotel, Convention Level
  Megan Perron, RN, BScN
- **Suturing/Knot-tying**
  Pier 4-Hotel, Convention Level
  George M. Ibrahim, MD

1:30-1:55 p.m.
Concurrent Breakouts repeated

1:55-2:15 p.m.
Beverage Break

2:15-2:45 p.m.
Minimally Invasive Endoscopic Strip Craniectomy: Long-term Follow-up with Patients and Families
Cathy Cartwright, NP

2:45-3:15 p.m.
Imaging and Clearance of Cervical Spine Trauma
Helen Branson, MD

3:15-3:45 p.m.
Spinal Orthotics in Children
Andrew H. Jea, MD, FAANS

3:45-4:15 p.m.
Journey to Guideline Development for Halo Pin Site Care
Kaitlin Flynn, RN, BSc (Hons), BScN
Sandy Melo, RN

4:15-4:30 p.m.
Closing Remarks and Evaluations

PROGRAM SCHEDULE

TUESDAY, DEC. 3

6:45 a.m.-7 p.m.
Registration
Metropolitan Ballroom Foyer-Conference Center, Second Level

7-11 a.m.
ABPNS Board Meeting
Dockside 1-Hotel, Lower Level

8 a.m.-4:30 p.m.
Mid-Level Practitioner's Seminar
Harbour Ballroom AB-Hotel, Convention Level

8:30 a.m.-4:30 p.m.
Practical Clinic: Pediatric Epilepsy Surgery
University of Toronto, Surgical Skills Centre

Transportation and lunch provided.
Shuttle will depart from hotel's street level entrance at Queen's Quay at 7:30 a.m.

Participants will absorb a full day of lectures interspersed with hands-on cadaver dissections. Learn to describe the current strategies for the selection of pediatric epilepsy patients, demonstrate the various surgical techniques for respective epilepsy surgeries, and outline those surgical results, their possible complications and complication prevention.

Course Directors:
James T. Rutka, MD, PhD, FAANS
James M. Drake, MD, MSc, FAANS

Faculty:
Sanjiv Bhatia, MD, FAANS
Mony Benifla, MD
Jeffrey P. Blount, MD, FAANS
Walter J. Hader, MD, FAANS
Clement Hamani, MD
Mojgan Hodaie, MD, FAANS
John R.W. Kestle, MD, FAANS
Ashutosh Singhal, MD
Carter Snead, MD

Attendees will receive a maximum of 7.5 *AMA PRA Category 1 Credits™* for this practical clinic.

This is a ticketed event.

Supported in part by educational grants from Ad-Tech Medical Instrument Corporation, Baylis Medical and Medtronic.

In-kind equipment support from Ad-Tech Medical Instrument Corporation, Baylis Medical and Medtronic.

12-4 p.m.
Executive Committee Meeting
Queens Quay-Conference Center, Street Level

4-6 p.m.
Speaker Ready Room
Bay Room-Conference Center, Street Level

4-4:30 p.m.
Education Committee
Queen's Quay-Conference Center, Street Level

6-7:30 p.m.
Opening Reception
Pier 4 and 5-Hotel, Convention Level

Supported by a grant from Medtronic.

WEDNESDAY, DEC. 4

6:15 a.m.-5 p.m.
Registration
Metropolitan Ballroom Foyer

6:45-7:45 a.m.
Breakfast Seminar: Developing a Research Career in Pediatric Neurological Surgery
Queen's Quay-Conference Center, Street Level

Moderator:
Catherine A. Mazzola, MD, FAANS

Panelists:
John R. W. Kestle, MD, FAANS
Peter B. Dirks, MD

Participants will hear advice from experienced clinical and basic science researchers on what it takes to succeed as a neurosurgeon-scientist. This will include a discussion about appropriate preparation during residency for a research career, opportunities and challenges during early faculty years, and avenues of advancement later in career.

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

This is a ticketed event.

7 a.m.-5:30 p.m.
Exhibit Hall Open and e-Poster Viewing
Metropolitan Ballroom Centre/West-Conference Center, Second Level

7:15-7:55 a.m.
Continental Breakfast in the Exhibit Hall

PROGRAM SCHEDULE

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

7:55-8 a.m.

Welcome and Opening Remarks

Bruce A. Kaufman, MD, FAANS
Pediatric Section Chairman

8-9 a.m.

Scientific Session I: Neoplasm I

Moderators:
Samuel H. Cheshier, MD, PhD
Nalin Gupta, MD, PhD, FAANS

8-8:10 a.m.

1. Intraoperative Ultrasound in Pediatric Brain Tumors: Does the Surgeon Get it Right?

Ashutosh Singhal, MD, FRCSC; Alexander Hengel, BS (Vancouver, Canada)

8:10-8:20 a.m.

2. Overcoming Brain Tumor Immune-evasion by Disrupting the CD47 SIRPα Axis toTreat High Grade Pediatric and Adult Brain Tumors

Sharareh Gholamin, MD; Sharareh Gholamin, MD; Siddhartha S Mitra, PhD; Achal S Achrol, MD; Suzana Kahn, PhD; Abdullah Feroze, MD; Chase Richard, BS; Micheal Zhang, BS; Anne Katherine Volkmer, MD; Jens Peter Volkmer, MD; Yoon Jae Cho, MD; Hannes Vogel, MD; Gary K. Steinberg, MD, PhD; Michael S.B. Edwards, MD; Irving Weissman, MD; Samuel Cheshier, MD, PhD (Stanford, CA)

8:20-8:30 a.m.

3. Diffusion Tensor Tractography for Presurgical Evaluation of White Matter Displacement by Brainstem Lesions in Children

Robert Lober, MD, PhD; Kristen Yeom, MD; Samantha Holdsworth, PhD; Michael Edwards, MD (Stanford, CA)

8:30-8:40 a.m.

4. Long-term OutcomeAfter Surgery for Spinal Cord Astrocytomas in Children

Francesco Sala, MD; Ema Tot, MD; Albino Bricolo, MD; Franco Faccioli, MD (Verona, Italy)

8:40-8:50 a.m.

5. Surgery and Adjuvant Radiotherapy Improve Survival in a Preclinical Mouse Model of Ependymoma**

Michael George DeCuypere, MD; Nidal Boulos, PhD; Jason Dapper, PhD; Paul Klimo, MD; Richard Gilbertson, MD, PhD (Cordova, TN)

8:50-9 a.m.

6. Pediatric Choroid Plexus Tumors: Epidemiology, Treatments, and Outcome Analysis on 198 Children from the SEER Database**

Roy William Roland Dudley, MD, PhD, FRCS(C); Michelle Torok, PhD; Danielle Gallegos, BS; Arthur Liu, MD, PhD; Michael Handler, MD; Todd Hankinson, MD (Aurora, CO)

9-10 a.m.

Clinical Symposia: Pediatric Gliomas- The Changing Landscape

Moderator:
Michael D. Taylor, MD, PhD

Panelists:
David Ellison, MD, PhD
Jan Gronych, PhD
Nada Jabado, MD, PhD
Paul Northcott, PhD, MSc

10-10:30 a.m.

Beverage Break in the Exhibit Hall

10:30-11:10 a.m.

Scientific Session II: Quality, Outcomes, Complications

Moderators:
Mark D. Krieger, MD, FAANS
Jay K. Riva-Cambrin, MD

10:30-10:40 a.m.

7. Physical Performance, Social Participation, and Medical Utilization in Childhood Brain Tumor Survivors

Sarah Elizabeth Boop; Kendra Jones, MS; Webb Smith, MS; Frederick Boop, MD; Gregory Armstrong, MD; Leslie Robison, PhD; Melissa Hudson, MD; Kirsten Ness, PhD (Germantown, TN)

10:40-10:50 a.m.

8. The Revision Quotient - A Quality Measure for Surgical Treatment of Hydrocephalus - Can Be Risk Adjusted

Joseph H. Piatt, Jr., MD; Christina Freibott (Merion Station, PA)

10:50-11 a.m.

9. Assessing Health-Related Quality of Life in Children with Spina Bifida

Brandon G. Rocque, MD; Ralee' Bishop; Mallory Scoggin; Betsy Hopson; Anastasia Arynchyna, MS; Christina Boddiford, MS; Chevis Shannon, MBA; Jeffrey Blount, MD (Birmingham, AL)

11-11:10 a.m.

10. In-Situ Pediatric Simulation Training for the Management of Neurosurgical Operative Crises**

Yasser Jeelani, MD; Peter Weinstock, MD, PhD; Alan Cohen, MD; Shenandoah Robinson, MD (Boston, MA)

11:10 a.m.-12 p.m.

Raimondi Lecture

Bryce R. Taylor, MD

Medical Leadership: Ten Things I've Learned

12-1 p.m.

Lunch and Book Signing in the Exhibit Hall

1-2:40 p.m.

Scientific Session III: Hydrocephalus I

Moderators:
John C. Wellons III, MD, FAANS
William E. Whitehead, MD, MPH, FAANS

11. Shunting Outcomes in Post-Hemorrhagic Hydrocephalus (SOPHH): results of a Hydrocephalus Clinical Research Network (HCRN) prospective cohort study

John C. Wellons III, MD; Chevis Shannon, PhD; Jay Riva-Cambrin, MD, MSC; Abhaya Kulkarni, MD, PhD; David Limbrick, MD, PhD; William Whitehead, MD, MPH; Samuel Browd, MD, PhD; Jerry Oakes, MD; Curtis Rozzelle, MD; Tamara Simon, MD, MPH; Mandeep Tamber, MD, PhD; John Kestle, MD, MSC (Nashville, TN)

1:10-1:20 p.m.

12. Risk Factors for First Cerebrospinal Fluid (CSF) Shunt Infection: Findings from HCRN's Multi-center Prospective Cohort Study

Jay Riva-Cambrin, MD, MSC; Tamara D. Simon, MD, MPH; Jerry Butler, MS; Kathryn Whitlock, MS; Samuel Browd, MD, PhD; Richard Holubkov, PhD; John Kestle, MD, MSC; Abhaya Kulkarni, MD, PhD; Marcie Langley, BS; David Limbrick, MD, PhD; Nicole Mayer-Hamblett, PhD; Mandeep Tamber, MD, PhD; John Wellons III, MD, MS; William Whitehead, MD, MPH (Seattle, WA)

1:20-1:30 p.m.

13. Early Treatment of Neonatal Intraventricular Hemorrhage-Associated Hydrocephalus with Systemic Deferoxamine**

Jennifer Strahle, MD; Thomas Garton; Harish Kilaru; Hugh Garton, MD; Karin Muraszko, MD; Cormac Maher, MD; Richard Keep, PhD; Guohua Xi, MD (Ann Arbor, MI)

1:30-1:40 p.m.

14. Fidelity Study of a New Synthetic Simulator for Endoscopic Third Ventriculostomy

Gerben Breimer; Vivek Bodani; James Drake (Renkum, Netherlands)

1:40-1:50 p.m.

15. Endoscopic Third Ventriculostomy (ETV) with Choroid Plexus Cauterization (CPC) in Infants with Hydrocephalus: a Retrospective Hydrocephalus Clinical Research Network (HCRN) Study

Abhaya Vivek Kulkarni, MD, FRCS; Jay Riva-Cambrin, MD, MSC; Samuel Browd, MD, PhD; James Drake, MD; Richard Holubkov, PhD; John Kestle, MD, MSC; David Limbrick, MD, PhD; Curtis Rozzelle, MD; Tamara Simon, MD; Mandeep Tamber, MD, PhD; John Wellons, MD, MPH; William Whitehead, MD, MSC (Toronto, Canada)

1:50-2 p.m.

16. Intraventricular Hemorrhage Clot Lysis Using MR-guided Focused Ultrasound in a Neonatal Piglet Model

Thomas Looi; Adam Waspe, PhD; Andrew James, MBBS; Kullervo Hynynen, PhD; James Drake, MBBS (Toronto, Canada)

2-2:10 p.m.

17. The effect of hydrocephalus on SVZ progenitor proliferation

June Goto; June Goto, PhD; Weihong Yuan, PhD; Kenneth Campbell, PhD; Francesco Mangano, DO (Cincinnati, OH)

2:10-2:20 p.m.

18. Test Characteristics of Quick-Brain MRI for Ventriculoperitoneal Shunt Evaluation in Children

Nathan R. Selden, MD, PhD; Esther Yue, MD; Garth Mecker, MD, MS; Ross Fleischman, MD, MSC; Dianna Bardo, MD; Amity Chu, BA; Eugene Vu, BA; David Spiro, MD, MPH (Portland, OR)

2:20-2:30 p.m.

19. Engineering a Gentler Touch: A Novel Pressure-Sensing Skin for Detecting Impending Tissue Damage during Neuroendoscopy**

Patrick James Codd, MD; Arabagi Veaceslav, PhD; Andrew Gosline, PhD; Pierre Dupont, PhD (Boston, MA)

PROGRAM SCHEDULE

2:30-2:40 p.m.

20. Vulnerable and Resilient White Matter Structures in Experimental Hydrocephalus - A Diffusion Tensor Imaging Study

Ramin Eskandari, MD; Osama Abdullah, BS; Cameron Mason; Kelley Deren-Lloyd, MS; Amanda Oechsle; James P. (Pat) McAllister, PhD (Mountain View, CA)

2:40-3:10 p.m.

Beverage Break in the Exhibit Hall

3:10-4:30 p.m.

Scientific Session IV: Spine and Trauma

Moderators:
Richard C.E. Anderson, MD, FAANS
Andrew H. Jea, MD, FAANS

3:10-3:20 p.m.

21. Occipitocervical fusion in the pediatric population: Analyzing risk factors for nonunion.**

Marcus Dennis Mazur, MD; Walavan Sivakumar, MD; Jay Riva-Cambrin, MD; Jaes Jones; Douglas Brockmeyer, MD (Salt Lake City, UT)

3:20-3:30 p.m.

22. Spine Neuroimaging in Pediatric Abusive Head Trauma: A Comparative Study

Mark S. Dias, MD; Arabinda Choudhary, MD; Ramsay Isaac, MD (Hershey, PA)

3:30-3:40 p.m.

23. Odontoid Retroflexion Correlates with Degree of Tonsillar Ectopia in Children with Chiari I Malformation

Travis Ryan Ladner; Michael Dewan; Matthew Day; Chevis Shannon; Luke Tomycz; Noel Tulipan; John Wellons, III (Nashville, TN)

3:40-3:50 p.m.

24. The Thoracolumbar Injury Classification and Severity Score in Children: A Validity Study**

Sarah Tamara Garber, MD; Joseph Miller, MD; Curtis Rozelle, MD; Marion Walker, MD (Salt Lake City, UT)

3:50-4 p.m.

25. Neurogenesis and Migration after TBI in Immature Swine: Less Like Mice and More Like Children?

Beth Costine, PhD; Sabrina Taylor, PhD; Kristen Saliga, BS; Colin Smith, BS; Carter Dodge, MD; Declan McGuone, MD; Ann-Christine Duhaime, MD (Boston, MA)

4-4:10 p.m.

26. Comparison of the Infant Face Scale to the Pediatric Glasgow Coma Scale for Predicting Neurologic Severity and Outcome in Children < Two Years of Age

Rima Sestokas; Sarah Murphy, MD; Sharon Haire, NP; Ann-Christine Duhaime, MD (Boston, MA)

4:10-4:20 p.m.

27. Rapid MRI Protocols for Head Trauma Screening in the Emergency Department

Katie Lynn Pricola, MD; Jean Klig, MD; Ari Cohen, MD; Rima Sestokas, BS; Paul Caruso, MD; Ann-Christine Duhaime, MD (Boston, MA)

4:20-4:30 p.m.

28. Risk factors for deep venous thrombosis in pediatric traumatic brain injury

Sandi K. Lam, MD; Dominic Harris, BA (Chicago, IL)

4:30-5:30 p.m.

Wine and Cheese Reception in Exhibit Hall

Supported by a grant from Medtronic.

THURSDAY, DEC. 5

6:15 a.m.-5 p.m.

Registration

Metropolitan Ballroom Foyer

6:30-7:30 a.m.

Inaugural Polar Bear Classic 5K Run

No formal registration is required for this event. Further information is available at the registration desk. Join your colleagues for a brisk run along the harbor. All runners to meet outside the hotel by the harbor at 6:15 a.m., so run can start promptly at 6:30 a.m.

6:45-7:45 a.m.

Breakfast Seminar: Planning Your Career After Your Fellowship in Pediatric Neurological Surgery

Queen's Quay-Conference Center, Street Level

Moderator:
Catherine A. Mazzola, MD, FAANS

Panelists:
Lissa C. Baird, MD
W. Jerry Oakes, MD, FAANS

Participants will hear advice and "lessons learned" on developing a successful career in pediatric neurosurgery. The perspective of both a young pediatric neurosurgeon and an experienced division chair will be provided on all aspects of what to do - and what to avoid - in building a career.

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

This is a ticketed event.

7 a.m.-4 p.m.

Speaker Ready Room

Bay Room-Conference Center, Street Level

7 a.m.-3:00 p.m.

Exhibit Hall Open and e-Poster Viewing

7:15-8 a.m.

Continental Breakfast in the Exhibit Hall

8-9:45 a.m.

Scientific Session V: Epilepsy

Moderators:
Jeffrey P. Blount, MD
Howard L. Weiner, MD, FAANS

8-8:10 a.m.

29. Impaired Emergence of Intrinsic Connectivity Networks in Children with Medically-Intractable Focal Epilepsy**

George M. Ibrahim, MD; Benjamin Morgan; Elizabeth Donner, MD; Margot Taylor, PhD; Sam Doesburg, PhD; Mary Lou Smith, PhD; James Rutka, MD, PhD; O. Carter Snead (Toronto, Canada)

8:10-8:20 a.m.

30. Intraoperative MRI in Paediatric Epilepsy Surgery: 4 Years' Experience

Sasha Burn, MD (Liverpool, United Kingdom)

8:20-8:30 a.m.

31. Factors associated with epilepsy surgery failure in pediatric patients: A quantitative and qualitative analysis**

Dario J. Englot, MD PhD; Nalin Gupta, MD; Kurtis Auguste, MD (San Francisco, CA)

8:30-8:40 a.m.

32. Functional Connectivity Changes in Pediatric Medically-Refractory Temporal Lobe Epilepsy

Manish N. Shah, MD; Abraham Snyder, MD, PhD; Joshua Shimony, MD, PhD; David Limbrick, MD, PhD; Marcus Raichle, MD; Matthew Smyth, MD (St Louis, MO)

8:40-8:50 a.m.

33. A clinically-useful animation toolbox for visualization of seizure connectivity dynamics

Simeon M Wong; George Ibrahim, MD; Ayako Ochi, MD, PhD; Hiroshi Otsubo, MD, PhD; Tomoyuki Akiyama, MD, PhD; James Rutka, MD, PhD; O. Snead III, MD; Sam Doesburg, PhD (Toronto, Canada)

8:50-9 a.m.

34. Multistage MRI-guided Laser Ablation of Multiple Epileptogenic Foci in Children with Tuberous Sclerosis Complex**

Hoon Choi, MD; Amit Singla, MD; Yan Li, MD, PhD; David Carter, MD, PhD; Zulma Tovar-Spinoza, MD (Syracuse, NY)

9-9:10 a.m.

35. MRI-Guided Stereotactic Laser Ablation for Pediatric Temporal Lobe Epilepsy: Technique and Early Experience

Scellig S. D. Stone, MD, PhD; Joseph Madsen, MD (Brookline, MA)

9:10-9:20 a.m.

36. Reoperative Hemispherotomy: If at first you don't succeed.

Erin Kiehna, MD; Elysa Widjaja, MD; James Rutka, MD (Toronto, Canada)

9:20-9:30 a.m.

37. MRI guided laser ablation of single epileptic foci in children with intractable epilepsy: SUNY Golisano's Upstate experience

Zulma Sarah Tovar-Spinoza, MD; Amit Singla, MBBS; David Carter, MD; Sean Huckins, MS; Yaman Eksioglu, MD (Syracuse, NY)

9:30-9:45 a.m.

2012 Pediatric Section Research Awards

Recipients:
Management of Bone Flaps After Decompressive Craniectomy in Children: A Multicenter Collaboration
Sandi K. Lam, MD

PROGRAM SCHEDULE

Sports Participation for Children with Chiarai Malformation or Arachnoid Cysts
Cormac O. Maher, MD

Risk Factors for Baclofem Pump Infection; A Multi-center Study
Jay K. Riva-Cambrin, MD

9:45-10:15 a.m.
Beverage Break in the Exhibit Hall

10:15-11:15 a.m.
Scientific Session VI: Functional/Spasticity

Moderators:
Daniel J. Curry, MD, FAANS
Elizabeth C. Tyler-Kabara, MD, PhD, FAANS

10:15-10:25 a.m.
38. Neural Stem Cell Transplantation: Two-Year Results of a Phase I Trial in Pelizaeus-Merzbacher Disease
Nalin Gupta, MD, PhD; Roland Henry, PhD; Jonathan Strober, MD; Sang-Mo Kang, MD; Daniel Lim, MD, PhD; Monica Bucci, PhD; Eduardo Caverzasi, PhD; Laura Gaetano, PhD; Maria Mandelli, PhD; Tamara Ryan, RN; Rachel Perry, RN; Jody Farrell, RN; Rita Jeremy, PhD; Mary Ulman, RN; Stephen Huhn, MD; James Barkovich, MD; David Rowitch, MD, PhD (San Francisco, CA)

10:25-10:35 a.m.
39. Reliability of the estimated thermal maps in predicting ablation volume during real-time magnetic resonance image-guided laser ablation in Epilepsy
Alexander Gregory Weil, MD; Sanjiv Bhatia, MD; Alexander Weil, MD; Parthasarathi Chamiraju, MD; Magno Guillen, PhD; Brad Fernald; John Ragheb, MD (Miami, FL)

10:35-10:45 a.m.
40. Clinical outcomes, dosing and side effects of intraventricular baclofen for the treatment of spastic quadriplegia and secondary dystonia
Taryn McFadden Bragg, MD; Emily Meyer (Madison, WI)

10:45-10:55 a.m.
41. Initial Experience of Auditory Brainstem Implants for Non-neurofibromatosis type 2 Children
Shaun D. Rodgers, MD; Jeffrey Wisoff, MD; J. Roland, MD; John Golfinos, MD (New York, NY)

10:55-11:05 a.m.
42. Transient Hemiparesis Following MR-Guided Visualase Ablation of Hypothalamic Hamartoma
Luke Tomycz, MD; Andrew Poliakov, PhD; Jeff Ojemann, MD, PhD (Nashville, TN)

11:05-11:15 a.m.
43. Does the additional surgery increase the risk of infection in drug pump implant surgery?
Michael David Partington, MD, FAANS; Linda Krach, MD; Emily Partington, BA; Samuel Roiko, PhD (St. Paul, MN)

11:15 a.m.-12 p.m.
AAP/SONS Special Lecture

Steven Miller, MDCM, FRCPC
Neonatal Neuro-intensive Care: Protecting the Developing Brain

12-1 p.m.
Lunch in the Exhibit Hall

1-2:30 p.m
Scientific Session VII: Hydrocephalus II

Moderators:
Samuel R. Browd, MD, PhD, FAANS
David D. Limbrick Jr., MD, PhD, FAANS

1-1:10 p.m.
44. Using a Two Variable Method in Radionuclide Shuntography to Predict Shunt Patency**
Eric M. Thompson, MD; Kate Wagner; Kassi Kronfeld; Nathan Selden, MD, PhD (Toronto, Canada)

1:10-1:20 p.m.
45. Fast Sequence MRI (fsMRI) studies for surveillance imaging in pediatric hydrocephalus**
Daxa Mahendra Patel, MD; Gigi Pate; James Johnston Jr, MD; Jeffrey Blount, MD (Birmingham, AL)

1:20-1:30 p.m.
46. Reverse Flow Micropump to Address Slit Ventricles and Proximal Obstruction in Shunted Hydrocephalus
Julian J. Lin, MD; Joshua Bailey, BS; Chris Frank, BS; Martin Morris, PhD; Kalyani Nair, PhD (Peoria, IL)

1:30-1:40 p.m.

47. Neural Progenitor Cells in the CSF During Hydrocephalus Can be Both Diagnostic and Therapeutic

Ramin Eskandari, MD; James (Pat) Patterson McAllister II, PhD; Maria Guerra, PhD; Karin Vio, PhD; M. Jara, BS; Roberto Gonzalez, MS; Nicole Lichtin, PhD; Paula Salazar, BS; Cesar Gonzalez, BS; Alexander Ortloff, PhD; Eduardo Ortega, MD; Jaime Jaque, MD; Sara Rodriguez, PhD; Conrad Johanson, PhD; Esteban Rodriguez, MD, PhD (Salt Lake City, UT)

1:40-1:50 p.m.

48. The Utility of Computed Tomography Evaluation of Ventricular Morphology in Suspected Cerebrospinal Fluid Shunt Malfunction**

Jonathan Nicholas Sellin, MD; Jacob Cherian, MD; James Barry, BA; Thomas Luerssen, MD; Andrew Jea, MD (Houston, TX)

1:50-2 p.m.

49. The British Antibiotic and Silver Impregnated Catheters for ventriculoperitoneal Shunts multi-centre randomised controlled trial (The BASICS Trial)

Presented by: Christopher James Parks, MBBS

Conor L Mallucci, MBBS FRCS; Michael Jenkinson, MBBS; John Hartley, MBBS; Carrol Gamble, PhD; Helen Hickey, MBBS; Dyfrig Hughes, PhD; Michaela Blundell, MD; Tom Solomon, PhD (Liverpool, United Kingdom)

2-2:10 p.m.

50. Longitudinal post-surgery DTI changes in children with hydrocephalus (HCP) and its predictive value for future behavioral outcome

Francesco T. Mangano, DO; Weihong Yuan, PhD; Stephanie Powell, PhD; Jannell Phillips, PhD; David Limbrick, MD, PhD; Joshua Shimony, MD; Mekibib Altaye, PhD; Robert McKinstry, MD; Scott Holland, PhD (Cincinnati, OH)

2:10-2:20 p.m.

51. What is the Risk of Infecting a Cerebrospinal Fluid (CSF) Diverting Shunt with Tapping?

Lindsey Spiegelman, M.D. Candidate; Richa Asija, BA; Stephanie Da Silva, BA; Mark Krieger, MD; J. Gordon McComb, MD (Newport Beach, CA)

2:20-2:30 p.m.

52. Reduction in Shunt Infection Rates by Applying Topical Antibiotics to Surgical Wounds Prior to Closure. A Comparison of One Surgeon's Experience Over Two Separate Five Year Periods.**

Joshua Marshall Beckman, MD; Lisa Tetreault, RN; Carolyn Carey, MD; Luis Rodriguez, MD; Gerald Tuite, MD (Tampa, FL)

2:30-3 p.m.

Beverage Break in the Exhibit Hall

3-4:30 p.m.

Scientific Session VIII: Neoplasm II

Moderators:
Jeffrey P. Greenfield, MD, PhD
David I. Sandberg, MD, FAANS

3-3:10 p.m.

53. Suprasellar pediatric craniopharyngioma resection via endonasal endoscopic approach**

Zarina S. Ali, MD; Shih-Shan Lang, MD; Ameet Kamat, MD; Nithin Adappa, MD; James Palmer, MD; Phillip Storm, MD; John Lee (Philadelphia, PA)

3:10-3:20 p.m.

54. Apparent Diffusion Coefficient Mapping in Medulloblastomas Predicts Non-infiltrative Surgical Planes**

Neena Ishwari Marupudi, MD; Deniz Altinok, MD; Luis Goncalves, MD; Steven Ham, DO; Sandeep Sood, MD (Detroit, MI)

3:20-3:30 p.m.

55. Risk of radiation-induced malignancies from computerized tomography (CT) scanning in children shunted before 6 years of age

Daniel H. Fulkerson, MD, FAANS; Ian White, MD; Kashif Shaikh, MD; Thomas Gianaris, MD (Indianapolis, IN)

3:30-3:40 p.m.

56. The Emerging Role of Intra-arterial Chemotherapy in the Management of Retinoblastoma: Safety, Efficacy, and Technical Aspects

Pascal Marcel Jabbour, MD; Nohra Chalouhi; Stavropoula Tjoumakaris, MD; L Fernando Gonzalez, MD; Carol Shields, MD; Robert Rosenwasser, MD (Philadelphia, PA)

3:40-3:50 p.m.

57. Presentation, Management and Outcome of Intrinsic Cervicomedullary Tumors in Children

Joseph Hiram McAbee, BS; David Daniels, MD, PhD; Frederick Boop, MD; Atmaram Pai Panandiker, MD; Asim Choudhri, MD; Brent Orr, MD, PhD; Paul Klimo, Jr., MD, MPH (Winston-Salem, NC)

3:50-4 p.m.

58. Effect of Reoperation(s) on Recurrent Glioblastoma in Pediatric Patients

Rupal Parikh, M.D. Candidate; Tong Yang, MD, PhD; Stephanie Da Silva, BA; Floyd Gilles, MD; Jonathan Finlay, MD; J. Gordon McComb, MD; Mark Krieger, MD (Piscataway, NJ)

PROGRAM SCHEDULE

4-4:10 p.m.

59. Predicting the Limits of the Endoscopic Endonasal Approach in Children: a Radiographic Anatomic Study

Philipp R. Aldana, MD; Carl Youssef, BS; Dale Kraemer, PhD (Jacksonville, FL)

4:10-4:20 p.m.

60. Methotrexate Infusion Directly into the Fourth Ventricle in Children with Malignant Fourth Ventricular Brain Tumors: A Pilot Clinical Trial

David I. Sandberg, MD; Soumen Khatua, MD; Michael Rytting, MD; Wafik Zaky, MD; Marcia Kerr, RN; Mary Tomaras, BS; Tiffany Butler, RN; Leena Ketonen, MD, PhD; Uma Kundu, MD; Bartlett Moore, PhD; Grace Yang (Houston, TX)

4:20- 4:30 p.m.

61. High Field Intra-Operative MRI - 4 Years Experience in Liverpool

Christopher James Parks, MBBS, FRCS(SN); Shivaram Avula, MD; Benedetta Pettorini, MD; Laurence Abernethy, MBBS; Conor Mallucci, MBBS (Manchester, United Kingdom)

4:30-4:45 p.m.

Annual Business Meeting

4:45-5 p.m.

SONS Business Meeting

6-10 p.m.

Evening at the Hockey Hall of Fame

Attendees will spend the evening enjoying food and beverage at this legendary venue. Browse the many displays, see The Esso Great Hall, home of the Stanley Cup, as well as participate in the Shoot Out and Shut Out interactive games. This is sure to be a fun evening for all.

Transportation is provided. Bus departure from hotel's street level entrance at Queen's Quay begins at 5:30 p.m.

This is a ticketed event.

FRIDAY, DEC. 6

6:15-11 a.m.

Registration

Metropolitan Ballroom Foyer

6:45-7:45 a.m.

Residents/Medical Students: Meet the Leadership Breakfast

Pier 2 and 3-Hotel, Convention Level

7-11 a.m.

Speaker Ready Room

Bay Room-Conference Center, Street Level

7-10:30 a.m.

Exhibit Hall Open and e-Poster Viewing

7:15-8 a.m.

Continental Breakfast in the Exhibit Hall

8-8:05 a.m.

Announcements

8:05-8:10 a.m.

2014 Amelia Island Meeting Preview

Philipp R. Aldana, MD, FAANS

8:10-9 a.m.

Scientific Session IX: Vascular/Craniofacial

Moderators:
Cormac O. Maher, MD, FAANS
Edward R. Smith, MD, FAANS

8:10-8:20 a.m.

62. Withdrawn

8:20-8:30 a.m.

63. POSTERIOR CALVARIAL EXPANSION USING CUSTOM MADE SPRINGS: THE EVOLUTION OF A SURGICAL TECHNIQUE

Owase Jeelani; Richard Hayward (London, United Kingdom)

8:30-8:40 a.m.

64. Efficacy Of Passive Helmet Therapy For Deformational Plagiocephaly: A Report of 1050 Cases

John Crantford, MD; Daniel Couture, MD; Aravind Somasundaram, BS; Claire Sanger, DO; Anne Argenta, MD; Lisa David, MD (Winston Salem, NC)

8:40-8:50 a.m.

65. Multiple Direct Extracranial to Intracranial Bypass Procedures In Combination With Indirect Revascularization In Pediatric Moyamoya Angiopathy managed at the Moyamoya Center, University Children's Hospital Zurich, Switzerland.

Nadia Khan, MD; Dubravka Deanovic, MD; Martin Hoelzle, MD; Alfred Buck, MD; Gerasimos Baltsavias, MD; Annette Hackenberg, MD; Barbara Plecko, MD (Zurich, Switzerland)

8:50-9 a.m.

66. Cerebral Vascular Malformations in Pediatric Hereditary Hemorrhagic Telangiectasia

June Yowtak, MD, PhD; Michael Woodall, MD; Ian Heger, MD; James Gossage, MD; Cargill Alleyne, MD (North Augusta, SC)

9-9:45 a.m

Clinical Symposia - New Advances in Cerebrovascular Disease

Moderator:
Peter B. Dirks, MD

Panelists:
Timo Krings, MD
R. Michael Scott, MD, FAANS (L)

9:45-10:15 a.m.

Beverage Break in the Exhibit Hall

10:15-10:20 a.m.

Hydrocephalus and Shulman Award Recipients Announced

10:20-11:20 a.m.

Scientific Session X: Congential/Other

Moderators:
Philipp R. Aldana, MD, FAANS
Kurtis I. Auguste, MD, FAANS

10:20-10:30 a.m.

67. Comparisons among prenatally predicted anatomical lesion level, actual anatomical lesion level, and early functional spinal level in myelomeningocele

Jeffrey Pugh, MD; Vanessa Rogers (Edmonton, Canada)

10:30-10:40 a.m.

68. Filum Terminale Lipomas: Imaging prevalence, natural history, and conus position

Cormac O. Maher, MD; Michael Cools, MD; Hugh Garton, MD, MSC; Karin Muraszko, MD; Mohannad Ibrahim, MD; Wajd Al-Holou, MD (Ann Arbor, MI)

10:40-10:50 a.m.

69. Conus Medularis Level in the vertebral column with transitional vertebrae

Amir Kershenovich, MD; Oscar Malo-Macias, MD; Faiz Syed, MD; Joseph Lock, MD; Gregory Moore, MD, PhD (Danville, PA)

10:50-11 a.m.

70. Withdrawn

11-11:10 a.m.

71. Utility of Furosemide in Reducing Blood Transfusion in Sagittal Craniosynostosis Surgery

Adil Harroud; Alexander Weil, MD; Jean Turgeon, MD; Claude Mercier, MD; Louis Crevier, MD, MSC (St. Laurent, Canada)

11:10-11:20 a.m.

72. Disclosure of conflicts of interest in published pediatric neurosurgery research: How do we compare?

Patrick J. McDonald, MD FRCSC; Emma Schon, BS (Winnipeg, Canada)

11:20-11:25 a.m.

Closing Remarks

James M. Drake, MD, MSc, FAANS
Meeting Co-Chair

ORAL ABSTRACTS

Please note: *All abstracts are published as submitted by their authors. The AANS is unable to make any changes to abstract submissions.*

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

1. Intraoperative Ultrasound in Pediatric Brain Tumors: Does the Surgeon Get it Right?

Ashutosh Singhal, MD, FRCSC; Alexander Hengel, BS (Vancouver, Canada)

Introduction: Intraoperative ultrasound (IOUS) is a valuable tool - inexpensive, adds minimal surgical time, and involves minimal risk. The diagnostic predictive value of IOUS is not fully characterized in Pediatric Neurosurgery. Our objective is to determine if surgeon-completed IOUS has good concordance with post-op MRI in estimating extent of surgical resection (EOR) of pediatric brain tumors.

Methods: We reviewed charts of pediatric brain tumor resections (single institution 2006-2013), including those with IOUS and immediate postoperative imaging.

Results: 57 cases were reviewed. The concordance of interpretation, between IOUS and post-op MR was 89.3%. Of 41 cases where IOUS suggested gross total resection, 35 were confirmed on MR (negative predictive value, NPV: 85%). All 15 cases where IOUS suggested subtotal resection were confirmed on MR (positive predictive value, PPV: 100%). IOUS had a 94% concordance with postoperative imaging in 33 infratentorial tumors and there was 83% concordance in 24 patients with supratentorial tumors.

Conclusion: The results from this study suggest that IOUS is reliable with residual tumor (PPV - 100%) but less so when it suggests no residual (NPV - 85%). These predictive values of IOUS suggest there is room for improvement in intra-operative tumor detection, either by improving the diagnostic validity of ultrasound, or by the addition of other intraoperative adjuncts.

2. Overcoming Brain Tumor Immune evasion by Disrupting the CD47 SIRPα Axis to Treat High Grade Pediatric and Adult Brain Tumors

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Introduction: Recent data suggests the interaction between tumor CD47 and macrophage SIRPα is a mechanism by which tumors evade immune responses. We hypothesized anti-CD47 therapy would result in effective anti-cancer immune activity against malignant brain tumors

Methods: CD47 expression was assessed in primary pediatric and adult brain tumors, including DIPG, Medulloblastoma, Glioblastoma, Oligodendroglioma, Ependymoma, ATRT and PNET. A humanized anti-CD47 monoclonal antibody lacking Fc-dependent functions was used to block CD47-SIRPα interactions in in vitro phagocytosis assays and in vivo orthotopic xenograft tumor murine models (OXTMs) from actual human brain tumor-initiating cells (BTICs). Toxicity studies were completed, including in vitro and in vivo assays of anti-CD47 antibody against normal neural stem cells (NSCs) and in non-human primate (NHP) toxicology studies.

Results: Increased CD47 correlated with worse progression-free survival, and CD47 surface protein was highly expressed in all brain tumors and on <90% of high-grade tumor cells. Increased CD47 was also observed in CD15+CD133+ putative BTICs. Anti-CD47 antibody increased tumor phagocytosis in vitro. Systemic anti-CD47 antibody therapy reduced tumor burden relative to control therapy in vivo in OXTMs and SBCMs. Survival analyses demonstrated progression to death in all control mice with long-term survival in all anti-CD47 treated mice. No toxicity was observed in NSCs in vitro or in vivo when injected alongside tumor cells. NHP studies demonstrated anti-CD47 antibody can be safely administered at therapeutic serum levels

Conclusions: Anti-CD47 therapy results in effective anti-cancer immune activity against pediatric and adult brain tumors.

3. Diffusion Tensor Tractography for Presurgical Evaluation of White Matter Displacement by Brainstem Lesions in Children

Robert Lober, MD PhD; Kristen Yeom, MD; Samantha Holdsworth, PhD; Michael Edwards, MD (Stanford, CA)

Introduction: Surgical resection or biopsy of brainstem is challenging due to proximity to critical structures. We hypothesized diffusion tensor tractography can be used to localize motor and sensory pathway fiber projections in relation to brainstem lesions.

Methods: Data of 17 consecutive children with brainstem masses were acquired using a 3T MRI GRAPPA DT-EPI sequence (25 isotropic directions with b 1000 s/mm2, slice thickness 3 mm). Fiber tracts were calculated with two seed regions for motor fibers: 1) precentral gyrus and 2) pyramidal tract at normal brainstem not occupied by the tumor; and two seed regions for sensory fibers: 1) medial lemniscus at pons and 2) postcentral gyrus. Tracking was performed with a curvature threshold of 30 degrees.

Results: For diffuse intrinsic pontine glioma (DIPG) in five children, eight of ten motor fibers traversed within the tumor along pontine pyramidal tracts. For pilocytic astrocytoma (9), ganglioglioma (1), and giant cavernous malformations (CM) (2) in 12children, 23 of 24 motor fiber projections were identified, showing variable displacement patterns in relation to tumor. In one case, motor fibers traversed enhancing tumor. Sensory projections at the brainstem were identified in all except two cases of DIPG and CM.

Conclusions: Tractography is feasible in patients with brainstem tumors or vascular malformations and provides information regarding the motor and sensory fibers that could be incorporated into surgical navigation for tumor biopsy or debulking.

4. Long term Outcome After Surgery for Spinal Cord Astrocytomas in Children

Francesco Sala, MD; Ema Tot, MD; Albino Bricolo, MD; Franco Faccioli, MD (Verona, Italy)

Introduction: The optimal treatment of intramedullary spinal cord astrocytomas (ISCA) in children remains controversial. We reviewed our clinical experience in a surgical series of 33 children to identify the role played by clinical, histological, and treatment-related factors in determining neurological outcome and survival.

Methods: Clinical charts, neuroimaging studies and operative notes were reviewed for all children operated on for ISCAs between 1983 and 2013. Neurologic function was graded according to the McCormick scale. Follow-up data of all contactable patients were updated through phone interviews

Results: Thirty-three children (18 males, 15 females; mean age 11 years) underwent surgery following a mean clinical history of 14 months. On admission most of them were on McCormick grade II (n=20) or I(n=7). Surgical removal was gross total in 15 cases, subtotal (<80%) in 15 and partial in 3. Pathology revealed pilocytic astrocytomas in 24 cases, astrocytoma grade II, grade III and grade IV in 3 cases each. Four children received adjuvant therapy.At a mean follow-up of 88 months, available for 30 children, 5 died within one year from surgery, 25 have either no disease (n=11),stable residual tumor(n=10), or slow progression (n=4). At the last follow-up, 18% of the children worsened, 26% improved, 56% were unchanged, as compared to pre-operatively.

Conclusions: While the prognosis for high grade tumors remain dismal, surgery plays a crucial role for low grade tumors. and should be performed precociously as the major determinant of long term neurological outcome is the preoperative neurological status.

5. Surgery and Adjuvant Radiotherapy Improve Survival in a Preclinical Mouse Model of Ependymoma**

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Introduction: Ependymoma is the third most common brain tumor in children, accounting for 10% of all pediatric tumors and 30% of tumors in children younger than 3 years of age. Despite recent data demonstrating that ependymomas from different CNS regions are distinct entities at the molecular level, treatment of this disease has changed little over past decades. Poor efficacy of trial chemotherapy can be attributed, in part, to a lack of accurate pre-clinical models.

Methods: Ependymoma cells (mEP915-RTBDN-LUC) were implanted into the cerebral cortex of 3 month-old CD-1 nu/nu immunocompromised mice (N=36). Mice were subjected to daily neurological assessment and weekly bioluminescence measurement. At 16 days post-implant, a cohort of mice underwent surgical resection (N=24). A subgroup of mice who underwent surgery also received adjuvant radiotherapy, beginning on post-operative day 5 (N=12; 40 Gy over 10 fractions). Tumor burden and overall survival was determined and compared to non-surgical controls (N=12).

Results: The histology of human ependymoma was faithfully recapitulated by the model. Surgical resection significantly prolonged survival in mice harboring these tumors. Median survival in the surgical group was 32 days post-implant compared to 20 days in non-surgical controls. Post-operative fractionated radiotherapy improved outcome further, extending median survival to 41 days. In addition, radiotherapy significantly decreased post-operative tumor burden as measured via bioluminescence.

Conclusions: This study validates an important pre-clinical mouse model of cerebral ependymoma by demonstrating that surgery and radiation improve survival. Future protocols utilizing chemotherapeutic targets in combination with surgery and radiotherapy are underway in hopes of ultimate human clinical translation.

6. Pediatric Choroid Plexus Tumors: Epidemiology, Treatments, and Outcome Analysis on 198 Children from the SEER Database**

Roy William Roland Dudley, MD, PhD, FRCS(C); Michelle Torok, PhD; Danielle Gallegos, BS; Arthur Liu, MD, PhD; Michael Handler, MD; Todd Hankinson, MD (Aurora, CO)

Introduction: Choroid plexus papillomas (CPPs) and carcinomas (CPCs) are rare neoplasms that affect mostly children. The epidemiology and outcomes are incompletely understood. The Surveillance, Epidemiology and End Results (SEER) databases allow adequately powered statistical analysis on rare tumors.

Methods: Data from SEER was used to analyze choroid plexus tumors in patients aged 0-19. The Kaplan-Meier method and log rank tests were used to investigate associations between independent variables and survival.

Results: SEER contained 102 CPPs and 96 CPCs, and the mean follow-up was 39 and 41 months, respectively. More than 75% of CPCs were diagnosed before the age of five, versus 45% for CPPs. Sixty-five percent of CPCs and 55% of CPPs occurred in males. In both groups more than 90% of children underwent surgical resection. Gross total resection (GTR) was achieved in 73.6% of CPCs and 63.7% of CPPs. Seventeen percent of CPCs were treated with radiation versus 1.0% of CPPs. Among those with CPC, 7% <5y received radiation, while 46% between 5-19y were treated with radiation. More than 98% of patients with CPP remain alive, versus 61% of CPC patients. Interestingly, however, CPC patients aged 15-19 had 100% 5-y survival. There was, however, no significant association between survival and age, sex, race, radiation, or surgical treatments for CPC.

Conclusions: CPC occurs in younger children, with a male predominance, and a worse prognosis than CPP. As such, CPC is treated more aggressively than CPP, with higher rates of GTR and radiation treatment. However, additional therapies are necessary to improve survival for these tumors.

7. Physical Performance, Social Participation, and Medical Utilization in Childhood Brain Tumor Survivors

Sarah Elizabeth Boop; Kendra Jones, MS; Webb Smith, MS; Frederick Boop, MD; Gregory Armstrong, MD; Leslie Robison, PhD; Melissa Hudson, MD; Kirsten Ness, PhD (Germantown, TN)

Introduction: Childhood brain tumor (CBT) survivors are at risk for treatment-related late effects including physical performance limitations (PPLs). PPLs may interfere with socioeconomic status (SES) and healthcare access. We evaluated associations between PPL, SES, and medical utilization among CBT survivors.

Methods: Participants completed medical and physical performance assessments. Data on SES (income, employment, insurance, and education) and medical utilization were obtained from questionnaire responses. PPLs were defined as impaired balance on the Sensory Organization Test, decreased ankle dorsiflexion, or decreased handgrip strength. Associations between PPLs, SES, and medical utilization were examined with structural equation modeling.

Results: 209 of 344 (41% female, mean age 26±5 years) eligible CBT survivors participated. Mean age at diagnosis was 8 years, with 39% of tumors being astroglial, 29% medulloblastoma, and 32% other tumor types. 47% of survivors had impaired balance, 31% had poor dorsiflexion, and 34% demonstrated handgrip weakness. In the two years prior to evaluation, 28% visited the doctor 7+ times, 19% had ≥1 hospitalization and 17% called the doctor 4+ times. 75% reported incomes <$20,000 per year, 41% were unemployed, 21% were uninsured and 10% did not graduate high school. Path analysis with latent constructs for PPL, SES and medical utilization indicated a positive association between less physical disability and SES (β=0.58, t=3.84, P<0.001). CBT survivors with less physical disability had lower medical utilization (β=-0.23, t=-1.99, P<0.05).

Conclusion: Physical health impacts social participation and medical utilization in CBT survivors. Better physical health is associated with higher SES and lower medical utilization.

8. The Revision Quotient – a Quality Measure for Surgical Treatment of Hydrocephalus Can Be Risk Adjusted.

Joseph H. Piatt, Jr., MD, FAANS; Christina Freibott (Merion Station, PA)

Introduction: The Revision Quotient [RQ] is the ratio of shunt revisions to new shunt insertions in a neurosurgical practice over a period of time. The RQ has been proposed as a measure of practice variation and quality in the surgical treatment of hydrocephalus. We report an exercise in risk adjustment.

Methods: The Kids' Inpatient Database was queried for 1997, 2000, 2003, 2006, and 2009 for admissions with diagnostic codes for hydrocephalus and procedural codes for CSF shunt insertion or revision. RQs were calculated on a hospital-wise basis. Hospitals with 12 or more insertions per year were characterized by region, size, NACHRI status, and teaching status and by clinical and demographic characteristics of patients undergoing initial treatment. A logistic regression model was developed to predict RQs greater than 1 standard deviation [SD] above the mean.

Results: There were 334 hospitals in the study group. The weighted mean [SD] RQ was 2.72 [1.26]. There was a clear trend toward increasing RQs with increasing hospital specialization as measured by NACHRI status. Interestingly, this trend was reflected in differences in weighted mean RQs among geographic regions. A multivariate model using NACHRI status and 3 characteristics of new patients predicted high RQ with an R^2 of 0.44 and an ROC area of 0.85. The predictive new patient characteristics were posthemorrhagic hydrocephalus, tumor-related hydrocephalus, and infancy.

Conclusions: A simple statistical model accounted for a surprisingly large fraction of the variance of the RQs in this study group. Regional differences in the RQ reflect practice variation that probably cannot be explained by clinical factors. Further study of the RQ using prospectively acquired data of greater clinical precision is warranted.

ORAL ABSTRACTS

9. Assessing Health Related Quality of Life in Children with Spina Bifida

Brandon G. Rocque, MD; Ralee' Bishop; Mallory Scoggin; Betsy Hopson; Anastasia Arynchyna, MS; Christina Boddiford, MS; Chevis Shannon, MBA; Jeffrey Blount, MD (Birmingham, AL)

Introduction: The purpose of this study is to explore various aspects of health related quality of life (HRQOL) in children with spinal dysraphism.

Methods: We enrolled a prospective cohort of 159 patients from the multi disciplinary spina bifida clinic. Surveys were distributed to caregivers of spina bifida patients age 5 and older. Data were collected using the HUI 3 multi attribute health utilities. Each participant received an overall HRQOL utility score and attribute specific subscores. These were correlated with demographic and treatment variables.

Results: There were 125 patients with myelomeningocele, 25 with lipomyelomeningocele, and few other dyraphisms. Among patients with myelomeningocele, 107 (86%) had CSF shunts in place; 14 (11%) had undergone Chiari 2 decompression, 58 (46%) were community ambulators and 45 (36%) were non ambulatory.Patients with myelomeningocele had significantly lower overall HRQOL scores than patients with closed spinal dysraphism. Among patients with myelomeningocele, younger patients had higher HRQOL scores (R squared=0.051, p=0.008). History of VP shunt was associated with worse HRQOL (overall score, ambulation, and cognition subscores). History of Chiari 2 decompression was associated with worse overall and cognition scores. Patients who could ambulate in the community had higher overall and ambulation scores. History of tethered cord release was correlated with lower pain subscore. No association was found between gender, race, insurance type, bowel or bladder continence and HRQOL.

Conclusions: Patients with myelomeningocele have significantly lower HRQOL scores than other spinal dysraphism patients. History of shunting and Chiari decompression correlate with lower HRQOL scores.

10. In Situ Pediatric Simulation Training for the Management of Neurosurgical Operative Crises**

Yasser Jeelani, MD; Peter Weinstock, MD, PhD; Alan Cohen, MD; Shenandoah Robinson, MD (Boston, MA)

Introduction: Simulation has been an effective method for training individuals in crisis management outside of the Operating Room. To enhance functional coordination during real high-risk neurosurgical emergencies, we developed a curriculum to simulate operative neurosurgical crises in children using native teams.

Methods: As part of the Boston Children's Hospital Simulation Program, we developed an in-situ curriculum to optimize Crisis Resource Management (CRM) by operative team members using common neurosurgical emergencies. Multi-disciplinary teams included attendings from critical care, neurosurgery and anesthesia, resident and fellow trainees, nursing, and ancillary staff. After an introduction to principles of CRM, simulator patients were used in three operative scenarios. Each scenario was followed by a structured group debriefing. For course assessment, each team member completed a 17-item questionnaire.

Results: Simulations were performed in the Surgical Intensive Care Unit and Operating Room with active management of the mannequin's clinical status by the simulation team. Scenarios were based on clinical vignettes that forced the team to deal with competing priorities frequently encountered in the management of critically ill neurosurgical patients. After sufficient interactive material was collected from each scenario, a structured debriefing session was held to identify common sources of suboptimal team performance, and to formulate approaches to avoid similar problems during real crises.

Conclusions: Pediatric simulation for optimal Crisis Resource Management is effective for training neurosurgical personnel to react efficiently in situations demanding the highest level of team coordination, prompt clinical judgment and decisive action in a concerted manner. Conducting the simulation in the native environment with native teams adds realism that enhances the learning process.

11. Shunting Outcomes in Post Hemorrhagic Hydrocephalus (SOPHH): results of a Hydrocephalus Clinical Research Network (HCRN) prospective cohort study

John C. Wellons III, MD, FAANS; Chevis Shannon, PhD; Jay Riva-Cambrin, MD, MSC; Abhaya Kulkarni, MD, PhD; David Limbrick, MD, PhD; William Whitehead, MD, MPH; Samuel Browd, MD, PhD; Jerry Oakes, MD; Curtis Rozzelle, MD; Tamara Simon, MD, MPH; Mandeep Tamber, MD, PhD; John Kestle, MD, MSC (Nashville, TN)

Introduction: Previous HCRN studies have shown a 15% difference in permanent shunt rates when retrospectively comparing ventriculosubgaleal shunts (SGS) to ventricular reservoirs (RES) in the treatment of hydrocephalus due to high grade IVH of prematurity. Further research in the same study line revealed a strong influence of center upon conversion outcome.

Methods: The 7 centers of the HCRN participated in at least an 18-month accrual period followed by 6 months of follow up. Decisions to Treat, Shunt, and Convert were standardized as were physical exam assessment and surgical technique. The primary outcome was the proportion that underwent conversion to permanent shunt. The major secondary outcomes of interest included infection rates.

Results: 99 premature infants were enrolled and met criteria for analysis. Using the standardized decision rubrics, 18 never reached threshold for treatment, 11 were initially permanently shunted, and 70 underwent temporization. The two temporization cohorts were similar in terms of IVH grade, BW, GA, and ventricular size. By Kaplan-Meier analysis, the proportion of SGS converted to permanent shunt at six months post-temporization was 86.3% and that for RES was 84.9%, logrank test p=0.91. The infection rate for SGS was 12.5% (3/24) and for RES was 20% (9/46), p=0.53.

Conclusions: Once management decisions and surgical techniques are standardized across HCRN sites, thus minimizing center effect, the observed difference in conversion rates is mitigated. Choice of temporization techniques in premature infants with IVH does not appear to influence rates of conversion to permanent ventricular shunts.

12. Risk Factors for First Cerebrospinal Fluid (CSF) Shunt Infection: Findings from HCRN's Multi-center Prospective Cohort Study

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Objective: To quantify the extent to which CSF shunt revision(s) are associated with increased risk of first CSF shunt infection, after adjusting for patient factors that may contribute to infection risk.

Methods: We used the HCRN registry to assemble a large prospective six center cohort of 1,036 children undergoing initial CSF shunt placement between April 2008 and January 2012. The primary outcome of interest was first CSF shunt infection.Data for initial CSF shunt placement and all subsequent CSF shunt revisions prior to first CSF shunt infection, where applicable, were obtained. The risk of first infection was estimated using a multivariable Cox proportional hazard model accounting for patient characteristics and CSF shunt revisions, and is reported using hazard ratios (HR) with 95% confidence intervals (CI).

Results: Of the 102 children who developed first infection within 12 months of placement, 33 (32%) followed one or more CSF shunt revisions. Baseline factors independently associated with risk of first infection included: gastrostomy tube

(HR 2.0, 95% CI: 1.1, 3.3), age 6-12 months (HR 0.3, 95% CI: 0.1, 0.8), and prior non-shunt neurosurgery (HR 0.4, 95% CI: 0.2, 0.9). After controlling for baseline factors, infection risk was most significantly associated with the need for revision (1 revision vs. none, HR 3.9, 95% CI: 2.2, 6.5; ≥2 revisions, HR 13.0, 95% CI: 6.5, 24.9).

Conclusions: This study quantifies the elevated risk of infection associated with shunt revisions observed in clinical practice.Since baseline factors contribute minimally, to reduce risk of infection risk further work should minimize revision procedures.

13. Early Treatment of Neonatal Intraventricular Hemorrhage Associated Hydrocephalus with Systemic Deferoxamine**

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Introduction: Neonatal intraventricular hemorrhage (IVH) may result in injury to the brain and hydrocephalus. The mechanism by which hydrocephalus occurs is unknown, with little data supporting the role of arachnoid granulations. Iron and hemoglobin are appealing targets to study in post-hemorrhagic hydrocephalus, as they are two chief components of blood.

Methods: The right lateral ventricle of neonatal (P7) Sprague Dawley rats was injected with 20 microliters of bovine hemoglobin (n=39), ferric iron (n=14) or artificial CSF (n=34). A subset of hemoglobin-injected rats (n=7) was treated with intraperitoneal deferoxamine (an iron chelator) two hours post injection and then BID for 24 hours. Magnetic resonance imaging was performed on all animals to determine ventricle size. Animals were euthanized 24 or 72 hours after injection and brains processed for Western blot and immunohistochemical analysis.

Results: Ventricular enlargement was observed after intraventricular injection of bovine hemoglobin (8.2 ±5.7 mm3) or iron (4.3 ±1.5 mm3) compared with artificial CSF (1.9 ±0.6 mm3)($p<0.001$). The key enzyme of heme degradation, heme-oxygenase 1, was increased in the periventricular and hippocampal regions of hemoglobin and iron-injected animals. Systemic treatment with deferoxamine reduced hemoglobin-induced ventricular enlargement (2.5±1.1 mm3 vs. 8.2 ±5.7 mm3; $p<0.01$) and ipsilateral cell death ($p<0.05$).

Conclusion: In our novel animal model, intraventricular injection of hemoglobin and its substrate iron results in ventricular enlargement, which is reduced by systemic treatment with the iron chelator deferoxamine. Early treatment with deferoxamine after neonatal IVH may reduce rates of hydrocephalus and is a possible avenue for future clinical trials.

14. Fidelity Study of a New Synthetic Simulator for Endoscopic Third Ventriculostomy

Gerben Breimer; Vivek Bodani; James Drake (Renkum, Netherlands)

Introduction: Endoscopic third ventriculostomy (ETV) is an effective but technically demanding procedure with significant risk. Current simulators including human cadavers, animal models and virtual reality systems are expensive, relatively inaccessible and can lack realistic sensory feedback. We have constructed a realistic low cost, reusable brain simulator for ETV and evaluated it for fidelity.

Methods: A brain silicone replica mimicking normal mechanical properties of a 4-month-old child with hydrocephalus was constructed, encased in the replicated skull and immersed in water. Realistic intraventricular landmarks included the choroid plexus, veins, mamillary bodies, infundibular recess, and basilar artery. The thinned out third ventricle floor which dissects appropriately, is quickly replaceable. Standard neuro-endoscopic equipment including irrigation is used. Bleeding scenarios and tumor biopsies are also incorporated. The simulator was tested for fidelity by means of questionnaires (5-point Likert-type items) with 16 neurosurgical trainees (PGY 1-6) and 9 pediatric and adult neurosurgeons.

Results: The simulator is portable, robust, and sets up in minutes. Over 95 % of participants agreed or strongly agreed that the simulator's anatomical features, tissue properties and bleeding scenarios were a realistic representation of that seen during an ETV. Participants stated that the simulator helped develop the required hand-eye coordination and camera skills, and was a valuable training exercise.

Conclusions: A low-cost reusable silicone-based ETV simulator realistically represents the surgical procedure to trainees and neurosurgeons. It can develop the technical and cognitive skills for ETV including dealing with complications.

15. Endoscopic Third Ventriculostomy (ETV) with Choroid Plexus Cauterization (CPC) in Infants with Hydrocephalus: a Retrospective Hydrocephalus Clinical Research Network (HCRN) Study

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Introduction: The use of ETV with CPC has been advocated as an alternative to CSF shunt in infants with hydrocephalus. There are limited reports of this procedure in the North American population, however. We provide a retrospective review of the ETV+CPC experience within the HCRN.

Methods: All children (<2 years old) who underwent an ETV+CPC at one of 7 HCRN centers before November 2012 were included. Data was collected retrospectively through review of hospital records and the HCRN registry.

Results: Thirty-six patients were included (13 with previous shunt). The etiologies of hydrocephalus were: 9 intraventricular hemorrhage of prematurity, 8 aqueductal stenosis, 4 myelomeningocele, and 15 other. There were no major intra-operative or early post-operative complications. There were 2 post-operative CSF infections. There were 2 deaths unrelated to hydrocephalus and 1 death from seizure. A total of 18 patients failed ETV+CPC at a median time of 30 days after surgery (range 4-484 days). The actuarial 3, 6, and 12 month success for ETV+CPC was 58%, 52%, and 52%. Near-complete CPC(<90%) was achieved in 11 cases (31%) overall, but in 50% (10/20) of cases in 2012 versus 6% (1/16) of cases before 2012($p=0.009$). Failure was higher in children with <90% of the choroid plexus cauterized (hazard ratio=4.39, 95% CI=0.999 to 19.2, $p=0.0501$).

Conclusions: Our early North American multicenter experience with ETV+CPC in infants demonstrates that the procedure has reasonable safety and efficacy in selected cases. The degree of CPC achieved might be associated with a surgeon learning curve and appears to affect success.

16. Intraventricular Hemorrhage Clot Lysis Using MR guided Focused Ultrasound in a Neonatal Piglet Model

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Introduction: Intraventricular hemorrhage (IVH) of prematurity with post hemorrhagic hydrocephalus remains a persisting problem. Clot lysis with intraventricular infusion of TPA showed promise, but with increased hemorrhagic complications. Cavitation from MR guided Focused Ultrasound (MRgFUS) is a non-invasive technique that induces thrombolysis. We investigated its efficacy in a neonatal piglet model of IVH.

Methods: Twenty-three 1-2 week olds piglets <3 kg had 3-5cc of autologous blood injected into the lateral ventricle using skull land marks with creation of an acoustic bone window. T1, T2 and BOLD sequences on 3T Achieva-MR quantified clot and targeting. Transcutaneous clot cavitation with MRgFUS at 300W, 100ms pulse duration, 60 sec intervals was implemented. The brains were examined for clot lysis and surrounding injury.

Results: Average lateral ventricle clot volume from MR data was .8 cc. The IVH clot was predominantly in the injected ventricle, but spread throughout the ventricular system and basal cisterns. Clot injection was well tolerated, although some survival animals had transient motor impairment with clot volumes < 1cc/kg. Optimization of the MRgFUS parameters is ongoing, but clot lysis was on the order of 25-50% in some animals and minimal brain injury.

Conclusions: The neonatal piglet model of IVH with an acoustic window appears to be a reasonable model for investigation of experimental IVH treatment. MRgFUS induced cavitation shows promise as a potential non-invasive thrombolytic therapy. The open fontanalle of a premature infant would be a natural acoustic window for MRgFUS.

17. The effect of hydrocephalus on SVZ progenitor proliferation

June Goto; June Goto, PhD; Weihong Yuan, PhD; Kenneth Campbell, PhD; Francesco Mangano, DO (Cincinnati, OH)

Introduction: Hydrocephalus is the most common condition in pediatric neurosurgery causing brain damage by elevated intracranial pressure. Developmental and behavioral morbidities include dysfunction of motor and cognitive functions, hyperactive, and altered behavior. The present study evaluated early changes in neurogenesis, inflammation, and neural progenitor subtypes in a rat model of pediatric hydrocephalus.

Methods: Obstructive hydrocephalus was induced by intracisternal kaolin injection at postnatal day 21 (P21) and was compared to saline-injected controls. This paradigm has previously been shown to result in abnormal behavior and hydrocephalus by P49. Animals were sacrificed 4 days after the injection (P25) and fluorescent immunohistochemistry was performed on serial forebrain sections with designated antibodies to evaluate neurogenesis (Ki67 and phospho-H3), inflammation (Iba-1 and GFAP), and neural progenitor subtypes (DCX, Mash1, and Sox2), respectively. 3D images by optical sectioning at the area of white matter tracks (corpus callosum, fornix, external and internal capsules) and sub ventricular zones were taken with ApoTome (Zeiss) and images were analyzed with Imaris software (Bitplane) to quantify cell number and sizes. Group difference was tested for statistical significance at the level of $p<0.05$ using student t-test.

Results: By P25, kaolin injected animals exhibited moderate but significant ventriculomegaly (Evans ratio, 0.381±0.012 (n=6) VS controls 0.315±0.008 (n=3), P=0.0138). Inflammatory reaction was elevated in SVZ and fornix. The number of neural progenitors undergoing cell division in the dorsal SVZ was reduced to 52% (control 7.66± 0.76 (%) VS kaolin 4.01±1.41 (%), P=0.0046), however, the total number of progenitors at this early stage of hydrocephalus did not appear to be affected.

Conclusions: Our results demonstrate that proliferation of neural progenitors is susceptible to moderate changes in ventricular size and inflammation at P25. Recent studies indicate that neurogenesis in the SVZ plays a role in repairing the damaged brain. Therefore, our results suggest the possibility for the involvement of neurogenesis defects in the progression and recovery from brain damage in hydrocephalus. This raises the possibility that manipulation of neural stem cells in the SVZ may alter behavior and the clinical outcome of pediatric hydrocephalus.

18. Test Characteristics of Quick Brain MRI for Ventriculoperitoneal Shunt Evaluation in Children

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Introduction: Quick-Brain Magnetic Resonance Imaging (QB-MRI) is a radiation-free modality for rapid unplanned imaging of the ventricular system, and may be used to detect ventriculoperitoneal shunt malfunction. QB-MRI scan requires less than 1 minute scanning time and usually does not require sedation. The authors compared the test characteristics of QB-MRI and computed tomography (CT) in detecting shunt malfunction as well as time from presentation to imaging.

Methods: An IRB approved retrospective review was undertaken at two pediatric tertiary care hospital Emergency Departments (EDs) for all children undergoing QB-MRI or CT for suspected shunt malfunction between July 2008 and June 2012. All studies were reviewed and reported by board-certified neuroradiologists, with ventricular size classified as normal, smaller, unchanged, or enlarged. Shunt malfunction was defined as occurrence of surgical shunt revision within 30 days of imaging. Use of sedation medications and anxiolytics during imaging were also recorded.

Results: A total of 720 children (473 QB-MRIs and 247 CTs) were included with a mean age of 7.2 years (range 22 days - 17.9 years) of which 62.5% were male. Surgical revision was required in 171 (23.8%). For CT, sensitivity was 50% (34.2% - 65.8%) and specificity was 95.6% (91.8% - 98.0%). For QB-MRI, sensitivity was 54.3% (95% CI 45.3% - 63.1%) and specificity was 95.9% (93.2% - 97.8%). The mean time from presentation to completion of CT was 82 minutes versus 114 minutes for QB-MRI (mean difference 31 minutes, 95% CI 20 - 43 minutes, $p<.0001$). This difference was primarily accounted for by a longer interval from order placement to imaging completion for QB-MRI. Medications for sedation or anxiolysis were used in 3.6% of CTs and 4.9% of QB-MRIs (p=0.39).

Conclusions: QB-MRI and CT have similar test characteristics in detecting shunt malfunction and a similar requirement for sedation or anxiolysis. QB-MRI however avoids radiation exposure in this population of children subject to frequent brain imaging

19. Engineering a Gentler Touch: A Novel Pressure Sensing Skin for Detecting Impending Tissue Damage during Neuroendoscopy**

Patrick James Codd, MD; Arabagi Veaceslav, PhD; Andrew Gosline, PhD; Pierre Dupont, PhD (Boston, MA)

Introduction: Force feedback mechanisms for the neuroendoscopist are critically lacking with current endoscopes. While visual cues from the endoscope tip allow avoidance of collateral anatomy, critical feedback regarding tissue deformation and trauma from the proximal endoscope components remains largely unavailable. We have successfully manufactured and tested a novel pressure-sensing polymer skin for use in pressure feedback during endoscopy.

Methods: A photolithography process on a silicon wafer was used to produce a pattern of 80um tall extrusions to serve as a positive mold for the sensor array. A thin layer of Polydimethylsiloxane (PDMS) polymer was molded onto these features. Demolding the polymer from the wafer, and sealing with another PDMS layer, resulted in microchannels. These microchannels were filled with a conductive liquid metal, and connected to recording hardware. Spiral channel patterns were designed to create a 3 x 3 array of pressure sensor pads which were wrapped around a standard neuroendoscope operating sheath. Pressure readings from the compressed sensor array were translated into a color-coded graphical user interface. Calibration experiments were conducted, and the sensor evaluated through cortical compression tests using explanted ovine brain.

Results: The sensing endoscope operating sheath was successfully calibrated to detect and display pressures within a range consistent with both normal and tissue-threatening compressions.

Conclusions: Endoscopy is increasingly important for navigating the narrow confines of the intracranial space. Techniques and tools for preventing collateral injury of neural structures is essential. We present a novel pressure sensing skin technology for improved pressure feedback during endoscopy.

20. Vulnerable and Resilient White Matter Structures in Experimental Hydrocephalus A Diffusion Tensor Imaging Study

Ramin Eskandari, MD; Osama Abdullah, BS; Cameron Mason; Kelley Deren-Lloyd, MS; Amanda Oechsle; James P. (Pat) McAllister, PhD (Mountain View, CA)

Introduction: Changes in Diffusion Tensor Imaging (DTI) parameters are non-invasive biomarkers of white matter (WM) alterations. Axial (AD) and radial (RD) diffusivity assess axonal and myelin integrity respectively. Along with Fractional anisotropy (FA) and mean (MD) diffusivity encompass a complete measure of WM integrity. We sought to determine relative vulnerability of WM structures in progressive neonatal hydrocephalus utilizing DTI.

Methods: Ventricular reservoirs were placed in 14-day-old kittens one (Early, n=9) or two (Late, n=9) weeks after hydrocephalus induction. Hydrocephalic and age-matched Controls (n=6) were sacrificed 12-weeks post-reservoir. Reservoir-taps were performed based on neurological deficit. Integrity of the optic chiasm (OC), optic tracts (OT), corpus callosum (CC) and internal capsule (IC) was evaluated using FA, AD, RD and MD. DTI measurements were grouped into less(<) and more(<) than six-weeks post-reservoir, corresponding to neurological deterioration.

Results: At <six-weeks FA decreased in the CC of both reservoir groups compared with Controls (p=0.0008). At <six-weeks the CC was visibly obliterated and FA lower in OC (p=.0496) and OT (p=0.0052) in the Late-group. The CC of the Early-group displayed increases in AD, RD and MD at <six-weeks (p=0.0026,0.0012 and 0.0002 respectively). The CC of the Late-group also demonstrated increases in RD and MD, but not AD at <six-weeks (p=0.01 and 0.0038 respectively). In the IC, FA and AD (Late-group) and AD and RD (Early-group) increased significantly.

Conclusions: In hydrocephalic animals treated with intermittent ventricular reservoir tapping, CC seemed most vulnerable. The IC remained most resilient although microstructural damage was suggested. The OC/OT displayed delayed myelin damage but intact axons.

21. Occipitocervical fusion in the pediatric population: Analyzing risk factors for nonunion.**

Marcus Dennis Mazur, MD; Walavan Sivakumar, MD; Jay Riva-Cambrin, MD; Jaes Jones; Douglas Brockmeyer, MD (Salt Lake City, UT)

Introduction: Pediatric occipitocervical fusion is a technically challenging procedure. Few studies have evaluated factors contributing to nonunion.

Methods: We conducted a double-reviewed retrospective cohort study of pediatric patients who underwent occipitocervical fusion from 2000 to 2013 at Primary Children's Medical Center to determine risk factors for fusion failure, as defined as the need for revision arthrodesis or instrumentation. Univariate and multivariate analyses were used to assess the association between fusion outcome and patient demographics, etiology of occipitocervical instability, type of occipitocervical instrumentation, graft, biological adjuncts, and complications.

Results: Of the 128 patients included, 21 developed nonunion and required revision surgery. Univariate analysis showed that patients with an infection or CSF leak had a significant association with requiring a revision operation (p=0.002). Patients with a unilateral construct had a higher failure rate with a trend toward significance (p=0.08). After multivariate analysis, unilateral construct (OR 4.2, CI [0.99,16.9]), infection (OR 9.9, CI [1.93, 58.0]), and CSF leak (OR 8.8, CI [1.12, 66.7]) retained significance as factors for requiring a revision operation. Etiology of instability, use of BMP, method of C2 fixation, type of occipital instrumentation, graft source, age, and number of operations were not associated with fusion failure.

Conclusions: Pediatric patients with unilateral constructs, postoperative wound infections requiring surgical debridement, and postoperative CSF leaks requiring surgical repair are associated with higher failure rates following occipitocervical fusion.

22. Spine Neuroimaging in Pediatric Abusive Head Trauma: A Comparative Study

Mark S. Dias, MD, FAANS; Arabinda Choudhary, MD; Ramsay Isaac, MD (Hershey, PA)

Introduction: A recent autopsy study suggests that spinal injuries are more common than previously suspected among children with abusive head trauma (AHT). We sought to assess the incidence of spinal injuries among survivors of AHT.

Methods: A retrospective comparative study evaluated three cohorts of children < 48 months having cervical spine MRI scans: 1) those with abusive head trauma (AHT), 2) those with accidental head injuries, and 3) those imaged for non-traumatic reasons. All neuroimaging studies were independently reviewed by two neuroradiologists.

Results: There was excellent interobserver agreement for spinal injury ($\kappa = 0.95$). Among 67 AHT cases, 6% had bone injuries. Ligamentous injuries were identified in 78% - nuchal ligament (78%), interspinous ligaments (64%), atlanto-occipital membrane (15%), atlanto-axial membrane (54%), ligamentum flavum (12%), and atlanto-axial or atlanto-occipital joint capsule (22%). Prevertebral edema was present in 13% and edema in the supradental space in 19%. Spinal subdural hemorrhage (SDH) ocurred in 48%; 44% involved cervical spine and 56% thoraco-lumbar spine. Among 46 accidentally injured children, one had bone injuries. Ligamentous injuries included the nuchal ligament (43%), interspinous ligaments (33%), and atlanto-occipital membrane (37%). Spinal SDH was seen in 1 case. Among 70 cases without trauma, only one case - a child with a 20 minute generalized seizure - had spinal abnormalities (nuchal ligament edema).

Conclusions: Cervical ligamentous injuries are more common in AHT than in accidental trauma; X-rays and CT miss < 90%.Spinal SDH is present in nearly half of AHT cases. We recommend whole spine MRI in AHT.

23. Odontoid Retroflexion Correlates with Degree of Tonsillar Ectopia in Children with Chiari I Malformation

Travis Ryan Ladner; Michael Dewan; Matthew Day; Chevis Shannon; Luke Tomycz; Noel Tulipan; John Wellons, III (Nashville, TN)

Introduction: While it is known that patients with Chiari I malformation (CM-I) have greater angulation of the odontoid process than the general population, the effect of odontoid retroflexion on the degree of tonsillar ectopia remains an open question. The authors review an institutional experience with odontoid angulation and tonsillar ectopia in pediatric CM-I.

Methods: A neuroradiologist retrospectively evaluated pre-operative MRI examinations on 79 pediatric CM-I patients undergoing posterior fossa decompression, obtaining measurements of odontoid retroflexion and tonsillar ectopia, as well as presence of syringomyelia. Retroflexion was classified according to the following: Grade 0 <90, Grade I 85-89, Grade II 80-84, and Grade III <80 degrees.

Results: The median angle of odontoid retroflexion was 81 degrees, ranging from 57 to 113 degrees. The percentages of patients with Grades 0-III angulation were 16.5%, 20.3%, 17.7%, and 45.5%, respectively. The median length of tonsillar ectopia was 14 mm, ranging from 1 to 33 mm. The mean lengths of tonsillar ectopia for Grades 0-III were 10.4, 13.4, 17.9, and 15.5 mm, respectively. On multivariate analysis controlling for age and sex, odontoid angulation was found to be an independent predictor of length of tonsillar ectopia (p=0.002). Every 10 degrees of retroflexion was associated with 1.9 mm of additional tonsillar ectopia.

Conclusions: These findings suggest a role for odontoid retroflexion in the pathogenesis of the cerebellar tonsil herniation observed in CM-I. Increasing angulation corresponded with increasing severity of tonsillar herniation. However, we did not observe a relationship between angulation and syringomyelia, the pathogenesis of which is likely multifactorial.

24. The Thoracolumbar Injury Classification and Severity Score in Children: A Validity Study**

Sarah Tamara Garber, MD; Joseph Miller, MD; Curtis Rozelle, MD; Marion Walker, MD (Salt Lake City, UT)

Introduction: The Thoracolumbar Injury Classification and Severity (TLICS) score was created to provide a standardized means of grading thoracolumbar spine injuries.

ORAL ABSTRACTS

The TLICS system has not been formally validated in a pediatric population.

Methods: Retrospective data from pediatric patients with acute, traumatic thoracolumbar fractures were analyzed from two Level 1 trauma centers. Demographic, mechanism of injury, and outcome data points were collected. The TLICS score was assigned by neurosurgical faculty based on computed tomography (CT) and magnetic resonance images (MRI). Statistical analysis was performed using JMP (SAS Institute, Cary, NC).

Results: One hundred and three pediatric patients with a mean age of 11.8 (±4.3) were enrolled. Motor vehicle accidents (n=33, 32%), falls (n=29, 28%), sports related (n=18, 17.5%), and trampoline injuries (n=7, 7%) were the most common mechanisms. The mean TLICS score was 2.21 (±2.35) and there was a trend for higher TLICS scores in older children (p=0.15). The positive predictive value of a pediatric patient requiring surgery with a TLICS score <4 was 88.9%. The specificity for surgery with TLICS <4 was 98.8%, athough the sensitivity was only 47%, as 9 patients with TLICS scores 4 or less underwent operative intervention. Sensitivity (88.2%) was improved if patients with TLICS greater than or equal to 4 were determined to require surgery.

Conclusions: The TLICS system is a valid method for evaluating pediatric thoracolumbar fractures. TLICS scores of 4 or greater were predictive of children requiring surgery though clinical judgment and further prospective study is warranted.

25. Neurogenesis and Migration after TBI in Immature Swine: Less Like Mice and More Like Children?

Beth Costine, PhD; Sabrina Taylor, PhD; Kristen Saliga, BS; Colin Smith, BS; Carter Dodge, MD; Declan McGuone, MD; Ann-Christine Duhaime, MD (Boston, MA)

Introduction: The subventricular zone (SVZ) is a site of postnatal neurogenesis. The SVZ produces neuroblasts that migrate to the site of injury in rodents. We have studied whether TBI stimulates neurogenesis or migration of neuroblasts in a large animal species.

Methods: Piglets on PND7 (infants), PND30 (toddlers), or at 4 months (pre-adolescents) underwent scaled cortical impact (N = 40). SVZ area was determined 7d post-injury. PND7 piglets (N = 23) received cortical impact or sham surgery, and BrdU, a marker of cell division, just prior to or after surgery to quantify neuroblasts in the white matter tract leading to the injured rostral gyrus 7d post-injury.

Results: SVZ area declined with age. SVZ area increased after TBI in PND30 piglets, but not PND7 nor 4 month old piglets. At PND14, 2 million neuroblasts were migrating through the white matter in the coronal plane, but migration in the sagittal plane was restricted to migratory streams: the rostral, dorsal, and ventral. In the white matter tract leading to the injury, the number of migrating neuroblasts was not increased in injured vs. sham piglets. Less than 1% of these were born just prior to or after injury; injured piglets had fewer BrdU+ neuroblasts than shams in this white matter tract.

Conclusions: Robust migration of neuroblasts to the injury site was not observed as has been reported in rodent models. It remains to be determined if neuroblasts incorporate into the lesional area. Alteration in migration patterns of neuroblasts after traumatic brain injury may impact neural development ontogeny.

26. Comparison of the Infant Face Scale to the Pediatric Glasgow Coma Scale for Predicting Neurologic Severity and Outcome in Children < Two Years of Age

Rima Sestokas; Sarah Murphy, MD; Sharon Haire, NP; Ann-Christine Duhaime, MD (Boston, MA)

Introduction: Neuroassessment tools used for trauma and other acute conditions have not been assessed for predictive validity in the youngest children. Challenges include small numbers with severe injuries and a paucity of age-appropriate outcome measures. This prospective study compared the Infant Face Scale (IFS) to a pediatric modification of the Glasgow Coma Scale (pGCS) in predicting neurological problem severity and short-term outcome.

Methods: Children <2 years presenting with acute neurological problems were enrolled. Worst IFS and pGCS scores within 24 hours, neuroimaging severity score, neurological therapy intensity level, discharge Pediatric Glasgow Outcome Scale-Extended, and Vineland Adaptive Behavior Scale-II at one month were collected.

Results: Sixty-nine participants were enrolled. At the mild end of the spectrum, there was no difference between worst IFS and pGCS in predicting neuroimaging severity (Spearman rho= 0.29 vs. 0.06), therapy intensity level (rho=0.04 vs. -0.07), or outcome (discharge rho=0.35 vs. 0.19; one month rho=-0.20 vs 0.21). The IFS more accurately identified less impaired intubated children compared to the pGCS (rho=-0.55 vs. -0.85). While our experience suggests the IFS better detects acute severe injuries in infants, results to date are underpowered to detect differences between the two scales at high severity.

Conclusions: This single-center study shows an advantage of the IFS in assessing intubated infants with milder impairments. The IFS has been incorporated into a national multi-center trial on traumatic brain injury (TRACK-TBI), which will be needed to provide sufficient subject numbers for assessing differences between IFS and pGCS in the youngest and most severely impaired children.

27. Rapid MRI Protocols for Head Trauma Screening in the Emergency Department

Katie Lynn Pricola, MD; Jean Klig, MD; Ari Cohen, MD; Rima Sestokas, BS; Paul Caruso, MD; Ann-Christine Duhaime, MD (Boston, MA)

Introduction: Traumatic brain injury results in 500,000 pediatric ER visits yearly, mostly after minor trauma. We utilized rapid sequence MRI as initial imaging obtained for children in our ER (some of whom had prior outside imaging) to reduce radiation exposure and increase sensitivity; we report our results.

Methods: Patients age 0-18 were identified using radiology codes and medical records were reviewed. Rapid acquisition T2 in 3 planes +/- susceptibility weighted imaging was performed. Age, sex, GCS or Infant Face Scale, mechanism of injury, time from injury to imaging, time from ED arrival to MRI, length of hospital stay, admission status (ICU or floor), and need for surgical intervention were determined.

Results: 29 patients (27days to 17years) with variable mechanisms all had a GCS or IFS <13;symptoms included loss of consciousness, nausea/vomiting, increased lethargy, or seizure. 10% required operative intervention, 31% were admitted to intensive care, 41% were discharged home from the ED, 31% of patients came with outside CT scans. Time from injury to CT was 1.8hr (range 1.25 to 6); time from ED arrival to MRI was 3.7hr (range 1.25-10hr). All patients discharged directly from the ED underwent MRI with no evidence of injury. There was no evidence of missed injury in any patient.

Conclusions: Establishing an institutional algorithm for rapid MRI has expedited wait time for MRI which is only slightly longer than non-contrast CT. Rapid MRI appears to be reliable for minor pediatric head trauma screening with decreased radiation exposure.

28. Risk factors for deep venous thrombosis in pediatric traumatic brain injury

Sandi K. Lam, MD; Dominic Harris, BA (Chicago, IL)

Introduction: The risk of deep venous thrombosis (DVT) in children with traumatic brain injury (TBI) has not been well characterized given its rarity in the pediatric population. Investigation of risk factors for DVT in this group requires the use of a large sample size. Using nationally representative hospital discharge data for 2009, we characterize the incidence and risk factors for DVT in children hospitalized for TBI.

Methods: We conducted a cross-sectional study using data from the Health Care Cost and Utilization Project (HCUP) Kid's Inpatient Database (KID) to examine DVT in TBI-associated hospitalizations for patients =<20 years old for the year 2009.

Results: 58,529 children had TBI-related admissions; 267 had DVT diagnoses. DVTs occurred in 4.56 per 1,000 TBI-associated hospitalizations compared to 1.20 per 1,000 pediatric hospitalizations overall. By adjusted logistic regression, patients significantly more likely to be diagnosed with DVT had the following: older age of 15-20 years (OR [odds ratio] 3.75, 95% CI 1.80-7.80), venous catheterization (OR 3.71, 95% CI 2.48-5.56), non-accidental trauma (OR 2.56, 95% CI 1.04-6.34), orthopedic surgery (OR 2.69, 95% CI 1.93-3.75), and cranial surgery (OR 2.27, 95% CI 1.42-3.63).

Conclusion: Using the Kid's Inpatient Database, we found risk factors for DVT in the setting of TBI in the pediatric population include older age, venous catheterization, non-accidental trauma, orthopedic surgery, and cranial surgery.

29. Impaired Emergence of Intrinsic Connectivity Networks in Children with Medically Intractable Focal Epilepsy**

George M. Ibrahim, MD; Benjamin Morgan; Elizabeth Donner, MD; Margot Taylor, PhD; Sam Doesburg, PhD; Mary Lou Smith, PhD; James Rutka, MD, PhD; O. Carter Snead (Toronto, Canada)

Introduction: Typical childhood development is characterized by the emergence of intrinsic connectivity networks (ICNs) by way of internetwork segregation and intranetwork integration. The intersection of childhood epilepsy and brain development is, however, poorly understood. Here, we evaluate the effects of intractable epilepsy on the emergence of ICNs in children.

Methods: Twenty-six children with medically-intractable localization-related epilepsy and 28 controls who were propensity-matched on the basis of age and sex underwent resting-state fMRI. Graph theoretical analysis of whole brain connectomes was applied to evaluate regional hubs (areas of high centrality). Seed-based analysis was then performed to evaluate differences in functional connectivity of identified hubs.

Results: Compared to propensity-matched controls, children with medically-intractable epilepsy demonstrated decreased centrality and age-related interactions in nodes of the salience and default mode networks. Seed-based connectivity and hierarchical clustering analysis revealed significantly decreased intra-network connections, and greater inter-network connectivity in children with epilepsy compared to controls. While increasing age was associated with greater intra-network integration and loss of inter-network correlation, significant interactions were identified with epilepsy duration, suggesting that a greater proportion of life with epilepsy may alter the developmental trajectory of affected children. Furthermore, subgroup analyses revealed that children with generalized seizures possessed impaired centrality of the thalamus, hippocampus, caudate and default mode network.

Conclusions: Children with localization-related epilepsy demonstrate alterations in the emergence and segregation of ICNs. These findings demonstrate the effects of epilepsy on the developing brain and provide support for early treatment of affected children. Following longitudinal validation studies, the identified impairments may serve as network biomarkers to assess efficacy of therapeutic interventions.

30. Intraoperative MRI In Paediatric Epilepsy Surgery: 4 Years' Experience

Sasha Burn, MD (Liverpool, United Kingdom)

Introduction: Tehnological advances do not necessarily equate to advantages for the patient and the cost of an intraoperative MRI (ioMRI) needs to be off set by its' usefulness. An audit of the use of the ioMRI in epilepsy patients over a 4 year period was completed examining the number of patients who had further resection following the ioMRI resulting in a complete resection.

Methods: An audit of paediatric epilepsy cases was performed between 16.6.09-31.7.13. Information was taken from the epilepsy surgery database and the PACS radiology system. The ioMRI in our unit is a 3-T scanner used with a ceiling mounted navigation system.

Results: 39 resective cases had an intraoperative MRI scan. Age range was 0.5 - 17.8 years. In 14 of the cases further surgery was performed following the ioMRI to complete the surgical intent. The case mix of the 14 cases was 7/16 temporal lobectomies (44%), 2/3 hypothalamic hamartomas (67%) and 5/12 lesionectomies (42%). There were no immediate complications identified by the ioMRI. Automatic registration following the ioMRI facilitated further safe and accurate complete resection in all cases.

Conclusions: In 14 (36%) of cases the availability of the intraoperative MRI meant that the patients avoided an extra trip to the MRI scanner post operatively and further surgery on a separate day. Confirmation of completion of surgical intent at the time of surgery is useful for the surgeon and extremely reassuring for the parents. The case mix of procedures which required further surgery indicates the challenging nature of these particular cases.

31. Factors associated with epilepsy surgery failure in pediatric patients: A quantitative and qualitative analysis**

Dario J. Englot, MD PhD; Nalin Gupta, MD; Kurtis Auguste, MD (San Francisco, CA)

Introduction: Resective epilepsy surgery can result in seizure freedom in some children, but other patients continue to suffer from seizures post-operatively. In order to improve surgical success rates and patients' quality of life, we examined the factors that contribute to treatment failure.

Methods: We performed a retrospective cohort investigation of pediatric patients who underwent focal resection for intractable epilepsy at our institution between 1998 and 2011.

Results: The overall cohort consisted of 110 patients who underwent a total of 115 focal resections, with post-operative follow-up of at least 1 (mean 3.1) year. The mean age was 12.3 (range 0-19) years at the time of surgery. Eighty-four resections (73%) resulted in freedom from disabling seizures (Engel I outcome), including 87% of 60 temporal lobe resections and 58% of 55 extratemporal resections. Significant quantitative predictors of seizure freedom (odds ratio and 95% CI < 1) included temporal lobe location, lesional pathology, age < 12 years, and low seizure frequency. Upon detailed qualitative analysis of preoperative and postoperative diagnostic data, factors most commonly associated with seizure recurrence (Engel II-IV outcome) included residual epileptic focus at the limits of the resection cavity (n = 8), a separate epileptic focus in a distant region (n = 6), hemispheric epilepsy syndrome such as hemimegalencephaly (n = 6), and intentionally limited resection to avoid eloquent brain regions (n = 3). In some of these patients, a second targeted surgical resection resulted in seizure freedom.

Conclusions: Defining the factors associated with failed epilepsy surgery may lead to refined patient selection and improved surgical strategies in the treatment of intractable pediatric epilepsy.

32. Functional Connectivity Changes in Pediatric Medically Refractory Temporal Lobe Epilepsy

Manish N. Shah, MD; Abraham Snyder, MD, PhD; Joshua Shimony, MD, PhD; David Limbrick, MD, PhD; Marcus Raichle, MD; Matthew Smyth, MD (St Louis, MO)

Introduction: Temporal lobe epilepsy (TLE) affects resting state brain networks in adults. This study aims to correlate resting state functional connectivity MRI (rsfcMRI) in major brain networks in pediatric TLE patients with their mesial temporal lobe structures.

Methods: From 2006 to 2011, 16 surgical TLE patients (7 left, 9 right) with a mean age of 9.9 years (0.9-18) were studied. Preoperative rsfcMRI was obtained

in patients with concordant lateralizing structural MRI, EEG and PET studies. Seed-based analysis was performed on bilateral amygdala and hippocampus seeds as well as 36 seeds representing major networks. The correlation of the rsfcMRI signal in each seed-seed pair was examined. The mean correlation of each seed-seed pair was assessed with a t-test, significance set at $p<0.05$.

Results: All 16 patients improved seizure frequency postoperatively with a mean follow-up of 2.3 years (0.4-4.5), with 12 patients seizure-free. When grouped for epileptogenic laterality, the histopathologically-confirmed diseased hippocampus had a negative mean correlation with the posterior cingulate cortex (PCC) while the normal hippocampus had a positive mean correlation ($p=0.04$). The diseased hippocampus had a more positive mean correlation with the ipsilateral amygdala than the normal hippocampus ($p=0.001$). The ipsilateral and contralateral amygdala seeds did not significantly differ in mean correlation with the diseased hippocampus ($p=0.17$).

Conclusions: There are functional connectivity changes in major networks in pediatric TLE patients, specifically with diminished connectivity between the affected hippocampus and the PCC, an important component of the default mode network. Preoperative rsfcMRI could offer an inexpensive, noninvasive method of confirming laterality in pediatric TLE.

33. A clinically useful animation toolbox for visualization of seizure connectivity dynamics

Simeon M Wong; George Ibrahim, MD; Ayako Ochi, MD, PhD; Hiroshi Otsubo, MD, PhD; Tomoyuki Akiyama, MD, PhD; James Rutka, MD, PhD; O Snead III, MD; Sam Doesburg, PhD (Toronto, Canada)

Introduction: Epilepsy is characterized by dysfunction of neural synchronization within specific networks. Improved understanding of synchrony-dependent functional connectivity of epileptic networks during seizures may be advantageous when planning resective surgery in children with drug-resistant epilepsy. Here, we present an analysis toolbox for producing and comparing real-time topographic animations of cortical functional connectivity in ECoG data.

Method: Ictal, preictal and interictal data were collected from 20 children undergoing invasive monitoring. Dynamic changes in functional connectivity among ECoG electrodes were indexed using the phase-locking value (PLV). Functional connectivity was analyzed over an optimized-width sliding window. The eigenvector centrality, a measure of hub-like network topology was determined for all electrodes based on the PLV at 7 canonical frequency bands. The results were rendered as videos to image changes in connectivity during seizure.

Results: The toolbox was successfully applied to visualize functional connectivity dynamics and network topologies throughout seizures. The sliding window width was optimized using simulated datasets for stability of mean PLV, while maintaining maximal dynamic range. Consistent functional connections emerged, coalesced and fractionated during the ictal course. In many cases, the seizure-onset zone was disconnected from surrounding cortex in the preictal and early ictal stages, relative to the interictal period. Mapping of functional connectivity dynamics was also useful in differentiating between seizure networks and non-epileptic eloquent networks during the ictal period, providing a demonstration of its clinical utility.

Conclusions: Visualization of dynamic epileptic functional connectivity using the presented animation toolbox may be clinically-useful in the presurgical evaluation of children with medical-intractable epilepsy.

34. Multistage MRI guided Laser Ablation of Multiple Epileptogenic Foci in Children with Tuberous Sclerosis Complex**

Hoon Choi, MD; Amit Singla, MD; Yan Li, MD, PhD; David Carter, MD, PhD; Zulma Tovar-Spinoza, MD (Syracuse, NY)

Introduction: Tuberous sclerosis complex patients (TSC) suffer from refractory seizures and developmental delay. There are primary and secondary epileptogenic zones. Multistage complex open surgical approach for localization and resection of these foci has been previously reported. We present a novel approach using sequential-staged MRI-guided laser ablation of multiple foci and its preliminary outcomes.

Methods: Three TSC patients with refractory seizures were chosen. After standard preoperative seizure evaluation, MRI-guided laser ablation was performed on the most epileptogenic tubers. Patients underwent post-ablation MRI and EEG.Two months later, localization was completed and newly active tubers were subsequently ablated. Engel scale was used to measure seizure control, and questionnaires were completed for quality of life.

Results: A 2-year-old female (Patient A) underwent ablation of bilateral foci over three stages. A 6-year-old male (Patient B) underwent ablation of right subependymal giant cell astrocytoma and three left-sided tubers over two stages. A 17-year-old female (Patient C), who failed a vagal nerve stimulator, underwent a single-stage ablation of two foci. All three patients demonstrated improved seizure control and quality of life. Parents reported cognitive improvement. Patients A and C were discharged on postoperative day 3. Patient B was discharged on postoperative day 4.

Conclusion: Multistage MRI-guided laser-ablation of multiple epileptogenic foci is a safe and effective surgical approach for TSC patients with refractory seizures. This is an emerging minimally invasive alternative to multistage complex open surgical approach. Further data on seizure control, pre and post-ablation neuropsychological evaluation and age-specific quality of life is anticipated.

35. MRI Guided Stereotactic Laser Ablation for Pediatric Temporal Lobe Epilepsy: Technique and Early Experience

Scellig S. D. Stone, MD, PhD; Joseph Madsen, MD (Brookline, MA)

Introduction: Nearly 1/3 of epilepsy patients are medically refractory, a subset of which benefit from surgery. In particular, surgery renders approximately 2/3 of those harboring temporal lobe lesions seizure free. MRI-guided stereotactic laser-induced interstitial thermal ablation offers both a less invasive alternative to traditional resective surgery and the ability to tailor lesioning by real-time visualization, with early series suggesting similar efficacy in adults but scarce data reported in children. Here we describe our technique and early experience in pediatric temporal lobe epilepsy.

Methods: Medically refractory patients with temporal lobe epilepsy were deemed surgical candidates based on clinical, EEG, imaging, and neuropsychiatric criteria. Visualase® laser ablation was performed under general anesthesia using CRW frame-based stereotaxic probe insertion in an MRI suite and using real-time thermal imaging.

Results: Of 8 patients treated to date, charts of 5 (3 female, 2 male; mean age 15.6 years) who underwent temporal lobe ablation for epilepsy between March and August 2013 were reviewed. Two had previously resected tumors (ganglioglioma and pilocytic astrocytoma), 2 had mesial temporal sclerosis, and 1 had hippocampal dysplasia. Right (1) and left (4) unilateral ablations were performed, with all patients discharged the following day. Of 3 patients with a mean chart follow-up of 1.5 months, 2 were seizure free and 1 had a single delayed seizure. The 2 remaining patients were seizure free just days post-treatment. 1 case required wound oversewing.

Conclusions: MRI-guided stereotactic laser ablation is a potentially safe and efficacious alternative to traditional surgery for pediatric patients with temporal lobe epilepsy, warranting further study.

36. Reoperative Hemispherotomy: If at first you don't succeed.

Erin Kiehna, MD; Elysa Widjaja, MD; James Rutka, MD (Toronto, Canada)

Introduction: Functional hemispherectomy for unilateral, medically refractory epilepsy, is associated with excellent long-term seizure control. However, for the 15-20% of children with recurrent seizures following disconnection, investigation

of recurrent seizures remains challenging, and surgical options are limited, but include conversion to anatomic hemispherectomy. Few studies examine the feasibility or efficacy of reoperative hemispherotomy. Utilizing diffusion tensor imaging (DTI), our goal was to determine if residual white matter association fibers could be identified after primary disconnection, and if a targeted approach to sever these residual connections leads to improved seizure control.

Methods: We identified 5 patients with recurrent seizures following a modified peri-insular hemispherotomy. Prolonged video-EEG recordings suggested persistent seizures arising from the affected hemisphere. In all patients, DTI demonstrated residual white matter association fibers connecting the hemispheres. A repeat craniotomy and neuronavigation-guided disconnection was performed.

Results: Five patients underwent initial hemispherotomy (median age 9.7mo) for hemimegalencephly (n=2), severe muitilobar cortical dysplasia (n=2), and Rasmussen's encephalitis (n=1). Average seizure freedom = 4yrs. Tractography demonstrated small but definite residual frontobasal connections in all. Median age at second surgery = 10.5yrs. Operative duration averaged 3hrs. Mean blood loss = 150cc (50-250cc); one patient required a blood transfusion. Three are seizure free, the remaining two are Engel class 2-3 (mean follow-up 15mo).

Conclusions: DTI has made reoperative functional hemispherotomy safe and effective. When combined with neuronavigation, residual association fibers may be identified and safely sectioned without necessarily converting to anatomic hemispherectomy. After reoperation for hemispherotomy with this approach, seizure outcome can be gratifying in the majority of patients.

37. MRI guided laser ablation of single epileptic foci in children with intractable epilepsy: SUNY Golisano's Upstate experience

Zulma Sarah Tovar-Spinoza, MD; Amit Singla, MBBS; David Carter, MD; Sean Huckins, MS; Yaman Eksioglu, MD (Syracuse, NY)

Introduction: Laser-induced thermal therapy (LITT) is an emerging technology for the treatment of intracranial pathologies. LITT uses laser-energy delivered through a fiberoptic catheter inserted into the lesion through a 3 mm cranial opening; the ablation is performed under MRI guidance. The literature on the use of LITT is limited in children with intractable epilepsy. We report our experience in children with single-epileptic-foci and seizures.

Methods: We present our initial experience with the use of LITT in four children with intractable epilepsy and different single intracranial lesions diagnosed as epileptogenic (2 tumors, 2 cortical dysplasia) treated with single or multiple lasers between November 2012-July 2013. Post-operative and short-medium term follow-up seizure and quality-of-life (QOLIE31) outcomes are evaluated.

Results: The age of the patients ranged from 4 to 18 years. No intra-operative or post-operative complications were noted. One patient had a transient post-ablation leg weakness. Short term follow up shows Engel I-II seizure control. QOLIE shows improvement in quality of life.

Conclusions: Laser-induced thermal therapy under MRI guidance appears both technically feasible and clinically safe to treat a variety of single epileptogenic focuses. Post-operative and short-term follow-up outcomes are promising. Larger series and long-term outcomes are needed to better define the indications and demonstrate the efficacy of this emerging technology.

38. Neural Stem Cell Transplantation: Two Year Results of a Phase I Trial in Pelizaeus Merzbacher Disease

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Introduction: Pelizaeus-Merzbacher Disease (PMD) is a rare leukodystrophy caused by mutation of the Proteolipid Protein 1 gene. Defective oligodendrocytes in PMD fail to myelinate axons causing global neurological dysfunction. Human central nervous system stem cells (HuCNS-SC) can develop into oligodendrocytes and confer structurally normal myelin when transplanted into a hypomyelinating mouse model.

Methods: An open-label Phase I study was undertaken to evaluate safety and to detect possible evidence of myelin formation after HuCNS-SC transplantation. Allogeneic HuCNS-SCs were surgically implanted into the frontal lobe white matter in four male subjects with an early-onset severe form of PMD. Immunosuppression was administered for 9 months. Serial neurological evaluations, developmental assessments and magnetic resonance imaging (MRI), including high angular resolution diffusion tensor imaging (DTI), were performed at baseline and during the two years following transplantation.

Results: The neurosurgical procedure, immunosuppression regimen, and HuCNS-SC transplantation were well tolerated. No clinical or radiological adverse effects were directly attributed to the donor cells. Reduced T1 and T2 relaxation times were observed in the regions of transplantation 9 months post-procedure in three subjects, and persisted in two subjects after two years. Normalized DTI showed increasing fractional anisotropy and reduced radial diffusivity, consistent with myelination, in the region of transplantation compared to control white matter regions remote to the transplant sites.

Conclusions: These Phase I findings indicate a favorable safety profile for HuCNS-SC in subjects with PMD. The MRI results suggest durable cell engraftment and donor-derived myelin in the transplanted host white matter.

39. Reliability of the estimated thermal maps in predicting ablation volume during real time magnetic resonance image guided laser ablation in epilepsy

Alexander Gregory Weil, MD; Sanjiv Bhatia, MD; Alexander Weil, MD; Parthasarathi Chamiraju, MD; Magno Guillen, PhD; Brad Fernald; John Ragheb, MD (Miami, FL)

Introduction: Real-time MRI-Guided Stereotactic Laser Thermal Ablation (RMLA) has recently emerged as an alternative for the surgical treatment of intractable lesional epilepsy. This technique allows real-time thermal monitoring of the ablation process, which allows feedback control over laser energy delivery to optimize destruction of desired epileptogenic/lesion area while preserving adjacent functional tissue. We seek to assess the accuracy of the estimated damage based on thermal maps in predicting actual immediate and long-term post-ablation lesional volume

Methods: Frame-based stereotaxy was used for fiber optic probe placement in the operating room and laser ablation was performed in the MRI suite. Real time MR thermal images allowed for the live evaluation of target ablation (temperature 50-900C. Diffusion weighted MR images were obtained during ablation to assess the cytotoxic lesion created. Follow-up images were obtained at 3 and 6 months post-ablation. A comparison between the estimated volume of thermal damage and the actual short-term (DWI-weighted MR) and long-term lesional (encephalomalacia) volume was performed

Results: Twelve refractory epilepsy patients with various cortical abnormalities were treated. Five patients achieved Engel I seizure control, four patients achieved Engel II control. Three patients continued to have seizures. Complications included misplacement of catheter, subarachnoid hemorrhage, hydrocephalus and visual field defect. Detailed thermal maps will be discussed

Conclusions: RMLA is an alternative to resective surgery in lesional epilepsy surgery. The success of this technique relies on the ability of real-time thermal maps to include the predicted epileptogenic zone as determined by preoperative studies while minimizing damage to surrounding areas

ORAL ABSTRACTS

40. Clinical outcomes, dosing and side effects of intraventricular baclofen for the treatment of spastic quadriplegia and secondary dystonia

Taryn McFadden Bragg, MD; Emily Meyer (Madison, WI)

Introduction: The aim of this study was to review clinical outcomes, dosing, and side effects for the largest reported series of patients with intraventricular baclofen (IVB) for the treatment of spastic quadriplegia, generalized secondary and heredo-degenerative dystonia.

Methods: Patients with severe dystonia and spasticity treated with IVB at the University of Wisconsin between 2005 and 2013 were identified in a retrospective chart review. Eighteen children and 6 adults were identified. All of the patients were unresponsive to oral medications prior to IVB therapy. Two patients had also failed intrathecal baclofen and one had failed DBS.

Results: Twenty-one of the 24 patients responded to IVB. Their mean dystonia scores using the Barry-Albright dystonia scale decreased significantly. Two of the patients who did not respond had not responded to previous high doses of intrathecal baclofen. One patient with Juvenile Huntington's disease worsened following placement of IVB. The average baclofen dose was 790 mcg/day (range 175-1700 mcg/day). Ten of 24 patients utilize flex dosing. Two patients developed infections requiring pump removal, 1 developed hydrocephalus requiring shunt placement, and one died from progression of disease. One patient reported sensitivity to light and sound. One patient developed visual and auditory hallucinations, and delusions, that resolved when the baclofen dose was decreased. Our patient with Juvenile Huntington's disease developed neuroleptic malignant syndrome, chorea and worsening hyperkinetic movements despite a positive baclofen trial prior to IVB.

Conclusions: We report the largest, single institution case series of patients with intraventricular baclofen therapy. IVB is a safe and effective method to treat severe, generalized secondary dystonia related (cerebral palsy, anoxic brain injury). It is unclear the benefits of IVB in regard to patients with primary and heredodegenerative dystonia. The effectiveness of IVB is perhaps related to higher concentrations at the cortical level. Despite this, higher baclofen doses are required for treatment.With increasing doses of IVB, prospective studies are needed to further characterize the potential side effects of IVB.

41. Initial Experience of Auditory Brainstem Implants for Non neurofibromatosis type 2 Children

Shaun D. Rodgers, MD; Jeffrey Wisoff, MD; J. Roland, MD; John Golfinos, MD (New York, NY)

Introduction: Auditory Brainstem Implant has been FDA approved for NF2 patients greater than 12 years old and adults. However, a population of deaf children without NF2 may benefit from ABI as an off label indication. ABI placement had been performed in 61 children in Europe as of 2011. It appears to be a potential intervention in prelingual patients with inner ear malformations and cochlear nerve hypoplasia or aplasia and certain patients deafened postlingually. Patients with failed cochlear implants may also be candidates.

Methods: Our multidisciplinary group has performed ABI operations in 3 children congenitally deaf with cochlear aplasia over the past year. We retrospectively reviewed our initial experience.

Results: All 3 patients underwent a retrosigmoid craniotomy for ABI placement. The lead was placed on the right in all 3 patients. The ages of the 3 patients were 9 years, 17 years, and 23 months. Our first patient is now 1 year post-implantation. The patient at his 6-month evaluation showed initial detection of low frequency speech at 20dBHL. However, there were no consistent responses to warble tones at any frequency and inconsistent alerting responses. However, at 1-year follow-up the patient demonstrates improved reliability for sound field thresholds performing play conditioned audiometry and visual reinforcement audiometry. Responses to warble tones were obtained at 35-40 dBHL. Speech detection was observed at 30 dBHL. Our complications have included: CSF leak, ileus, and syncope. All 3 patients tolerated the procedure and initial programming well by 3 months.

Conclusions: This is the first American report of the use of ABI in non-neurofibromatosis type 2 children. ABIs may provide clinical benefit in children for whom the device is not currently FDA approved. The surgeon must be prepared for numerous anatomic variants. The choroid plexus is the only constant landmark for the foramen of Luschka. In our initial experience it appears ABI placement in children is safe. Further evaluations of this novel approach will determine efficacy.

42. Transient Hemiparesis Following MR Guided Visualase Ablation of Hypothalamic Hamartoma

Luke Tomycz, MD; Andrew Poliakov, PhD; Jeff Ojemann, MD, PhD (Nashville, TN)

Introduction: Since 2012 MR-guided Visualase ablation was performed on 3 patients with hypothalamic hamartoma. As this is a relatively novel approach, we sought to report our complications with a focus on temporary weakness which may be due to heating of nearby corticospinal tracts.

Methods: We analyzed three patients with hypothalamic hamartoma and intractable seizures admitted to Seattle Children's Hospital since 2012: Patient 1 (22 yo male, 11 mm midline lesion), Patient 2 (24 yo male, 9 mm right-sided lesion), and Patient 3 (5 yo male, 7 mm right-sided lesion). Following MR-guided Visualase ablation of the lesion, medical records were reviewed to determine postoperative complications. MRI data was used to estimate the probable temperature to which nearby motor fibers were exposed.

Results: Two out of three (2/3) experienced profound but transient hemibody weakness which resolved almost entirely by postoperative day #1. Interestingly, while Patient 2 developed this weakness on the left-side of his body (contralateral to his lesion), Patient 3 developed hemiparesis ipsilateral to his lesion and still had mild residual facial weakness at one-year follow-up. Other complications were observed such as transient visual disturbances in Patient 1 that resolved with steroid administration and hyperphagia, aggressive behavior, and language hesitancy in Patient 3 that was not thought to be directly related to the procedure. In terms of the efficacy of the procedure on seizure outcomes, Patient 1 was lost to follow-up, Patient 2 had dramatic reduction in the frequency of his seizures, and Patient 3 obtained seizure freedom (on levetiracetam) after ablation.

Conclusions: MR-guided ablation is an effective therapy to eliminate or dramatically reduce the incidence of seizures in patients with hypothalamic hamartomas. Inadvertent heating of nearby corticospinal tracts within the internal capsule may explain transient postoperative weakness. Continued experience with this technique should allow the fine-tuning necessary to minimize these complications and better characterize the temperature threshold that leads to temporary dysfunction of adjacent white matter tracts.

43. Does the additional surgery increase the risk of infection in drug pump implant surgery?

Michael David Partington, MD FAANS; Linda Krach, MD; Emily Partington, BA; Samuel Roiko, PhD (St. Paul, MN)

Introduction: Recent publications have added to the understanding of possible developmental risk of anesthetic exposure in childhood. This fact, combined with family preferences for convenient scheduling single procedures whenever possible, prompted us to examine whether an additional procedure increased the risk of pump infection.

Methods: Retrospective study of single institution experience. With IRB approval, all pump implant or revision surgeries during a five year period (2006-2010) were reviewed. Pump explant procedures were excluded, as were those

with less than 1 year follow-up. Pump surgeries were classified as either isolated pump surgery, vs. those combined with other procedures. Infection rates were established for each group. Analysis was done using commercially available statistics packages.

Results: A total of 504 procedures were reviewed. Pump surgery was isolated in 422 instances. Combined surgeries included 34 with extremity surgery, 29 with spine surgery and 19 with injection therapy (botulinum toxin or phenol). All pumps were being used for tone management only. Infections occurred in 16/422 isolated surgeries (3.79%) vs. 6/82 (7.31%) of all combined procedures. This difference was not significant by chi-square (p=0.2). Sub-group pump infection rates were 2/34 extremity procedures (5.9%), 3/29 spine procedures (10.3%) and 1/19 injection procedures (5.3%) (all non-significant but had small sample sizes).

Conclusions: The addition of injection therapy or clean orthopaedic procedures does not increase the risk of pump infection.A trend towards increased risk in spine surgery may reflected the prolonged exposure and handling of exposed Silastic tubing.

44. Using a Two Variable Method in Radionuclide Shuntography to Predict Shunt Patency**

Eric M. Thompson, MD; Kate Wagner; Kassi Kronfeld; Nathan Selden, MD, PhD (Toronto, Canada)

Introduction: Radionuclide shuntography interpretation is nebulous when the tracer fails to enter the ventricle but quickly drains distally or when the tracer enters the ventricle but takes < 15 minutes to drain distally. The purpose of this study was to determine the sensitivity and specificity of the radionuclide shuntogram based on entry of tracer into the ventricle and time to distal drainage.

Methods: The results of 259 shuntograms were reviewed. Chi-squared analysis was performed to determine if valve type, ventricle size, distal location, and age affect shuntogram results. Two by two binary classification analyses were performed to determine what criteria constitute a "normal" versus "abnormal" shuntogram.

Results: Valve type, ventricle size, distal site, and age were not associated with shuntogram results (P<0.05). Shunt patency was confirmed surgically in 74 patients (28.6%) or presumed by follow up of ≥ 30 days. The sensitivity/specificity of all combinations of tracer ventricular entry and time to distal drainage were calculated to define a "normal" shuntogram. Sensitivity (37.5%) and specificity (81.3%) were lowest when the definition of a "normal" shuntogram included any tracer movement into the distal site within 45 minutes. Sensitivity (87.5%) and specificity (92%) were highest when definition of a "normal" shuntogram was limited exclusively to tracer entry into the ventricles and distal drainage within 15 minutes.

Conclusions: Valve type, ventricle size, distal site, and age did not affect shuntogram results. Shuntograms in which tracer fails to enter the ventricle and fails to drain distally within 15 minutes should increase suspicion for shunt obstruction.

45. Fast Sequence MRI (fsMRI) studies for surveillance imaging in pediatric hydrocephalus**

Daxa Mahendra Patel, MD; Gigi Pate; James Johnston Jr, MD; Jeffrey Blount, MD (Birmingham, AL)

Introduction: Surveillance imaging of the ventricles is invaluable in following children with shunted hydrocephalus. Yet, recent concern over radiation exposure calls for a new technique. Prior reports regarding fast sequence MRI (fsMRI) are limited. We incorporated fsMRI into our routine shunt surveillance imaging and report here a 5 year experience with these techniques.

Methods: We instituted fsMRI for routine surveillance in 2008 and have gradually increased our utilization as protocols have been refined. Sequences performed include an axial, coronal, and sagittal T2 haste. We conducted retrospective chart and imaging review after IRB approval. We rated each fsMRI according to five visibility parameters—ventricular size, configuration, transepyndemal flow, absence of motion artifact, and visualization of ventricular catheter. We also calculated inter-rater reliability between observers using Kendall's tau-b and intraclass coefficient.

Results: Two hundred patients were imaged with fsMRI. No child required sedation. The average duration of exams was approximately 3.37 minutes. Clinically useful images were attained in all cases. Overall fsMRI quality for the exams based on five different visibility parameters showed that 169 (84.5%) exams had statistically significant excellent quality. The Kendall's tau-b for the overall fsMRI ratings was 0.82 (p-value 0.002) and intraclass coefficient was 0.87 (p-value <0.0001).

Conclusions: In this cohort fsMRI studies demonstrated excellent overall quality that is statistically significant. We found a high degree of inter-rater reliability in assessment of fsMRI. Subsequently, we formulate fsMRI as an effective strategy for routine surveillance imaging in hydrocephalic patients that eliminates the need for sedation and eliminates the use of ionizing radiation.

46. Reverse Flow Micropump to Address Slit Ventricles and Proximal Obstruction in Shunted Hydrocephalus

Julian J. Lin, MD; Joshua Bailey, BS; Chris Frank, BS; Martin Morris, PhD; Kalyani Nair, PhD (Peoria, IL)

Introduction: Slit ventricles and proximal obstruction are common complications associated with shunted hydrocephalus. The authors of this study propose the use of an actively controlled system to introduce pulsatility and prevent catheter obstruction in current shunt system. A working prototype was designed around a pre-manufactured micropump and tested under simulated in vitro conditions. Pressure measurements and visualization data were recorded to assess benefits of incorporating such a device.

Methods: The micropump, in conjunction with a flexible reservoir, was integrated into the shunt system to generate pulsatile, retrograde flow while an acrylic housing with a vertical column of water simulated the ventricles and intracranial pressure. Differential pressure across the pump was measured during operation and used to generate mass flow rate data. Occlusion was simulated using rubber cement and flow was visualized via dye.

Results: Flow visualization and pressure measurements confirmed that the system was capable of eliminating simulated occlusion under in vitro conditions. Pressure within the proximal catheter was increased until the catheter holes were cleared of occlusion and visible backflow ensued. Intermittent pump actuation generated a pulsatile-like flow which restored normal shunt operation once the micropump was turned off.

Conclusions: Use of a micropump to create pulsatile, retrograde flow proves a viable option to actively eliminate occlusion within the proximal catheter. Moreover, such a system should be capable of preventing slit ventricles. Utilization of such an active device in vivo, however, introduces several issues to be addressed including powering and control methods.

47. Neural Progenitor Cells in the CSF During Hydrocephalus Can be Both Diagnostic and Therapeutic

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Introduction: The ventricular zone (VZ) lining the lateral ventricles contains neural stem cells (NSCs) while the subventricular zone (SVZ) harbors neural precursor cells (NPCs). Evidence from hydrocephalic human fetuses and mutant

animals indicates that a cell junction pathology in NSCs and NPCs leads to disruption of the VZ and SVZ. To determine the fate of the disrupted cells, we analyzed the differentiation of NSCs and NPCs obtained from hydrocephalic cerebrospinal fluid (hyCSF). In addition, we sought to explore cellular repair strategies including intraventricular neural stem cell grafting of neurospheres.

Methods: At postnatal day 1 (PN1), cells obtained from the VZ/SVZ of non-hydrocephalic HTx rats or the CSF of hydrocephalic HTx rats were cultured to produce neurospheres for 6-7 days (6-7DIV) and exposed to BrdU on the last day. Neurospheres were processed for immunofluorescence using antibodies for proliferation (BrdU), neuron and glial differentiation (nestin, beta-3-tubulin, GFAP), functional plasma membrane proteins (AQP4, caveolin 1) and adherent junctions (N-cadherin). After 7DIV some neurospheres were grown for 2 weeks in a culture medium free of growth factors and containing normal (nCSF) or hydrocephalic cerebrospinal fluid (hyCSF). Neurospheres from non-hydrocephalic rats were grafted into the lateral ventricle of PN7 hydrocephalic rats.

Results: NSCs and NPCs in the hyCSF proliferated and formed small and large neurospheres that progressively disassembled and formed new neurospheres; these neurospheres showed abnormal expression of junction proteins. In contrast, neurospheres from the non-hydrocephalic rats grew to form compact neurospheres that did not disassemble and contained junction proteins located normally at the plasma membrane. At 2DIV neurospheres began to differentiate into neurons and astrocytes. Following intraventricular injection of neurospheres into hydrocephalic rats, viable neurospheres were found throughout the lateral ventricles and some had migrated to sites of ependymal disruption.

Conclusions: Neurospheres grown from cells in the CSF may serve a novel diagnostic purpose and grafts of neurospheres may perform therapeutic functions that could be used in conjunction with ventricular shunting.

48. The Utility of Computed Tomography Evaluation of Ventricular Morphology in Suspected Cerebrospinal Fluid Shunt Malfunction**

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Introduction: Children with suspected cerebrospinal fluid (CSF) shunt malfunction are commonly evaluated with computed tomography (CT) or magnetic resonance imaging (MRI) of the brain. However, the clinical efficacy of cranial imaging in this setting is not well-defined. We conducted a study to determine if historical patterns of ventricular morphology during prior shunt malfunction added useful clinical information in the evaluation of new shunt malfunctions.

Methods: A retrospective chart review of children 3 years of age or older with two or more shunt revisions evaluated at Texas Children's Hospital from 2/20/2011 to 6/18/2013 was conducted. Patients with shunt infection but without shunt obstruction were excluded from the study. CT/MRI results were dichotomized into two distinct categories, as determined by radiologist's report: dilatation of the ventricular system in comparison to prior scans at points of shunt obstruction, or no dilation. The presence of shunt malfunction was confirmed by findings documented in the operative report.

Results: 42 patients were included in our study. There were a total of 117 patient encounters analyzed. There was an average of 2.79 encounters per patient. 27 patients (64 %) demonstrated dilatation of the ventricular system at the first episode of shunt obstruction, and consistently thereafter. 4 patients (10 %) demonstrated no dilatation at the first episode of shunt obstruction, and consistently thereafter. 11 patients (26 %) demonstrated inconsistent changes in ventricular size at times of shunt obstruction.

Conclusions: Historical CT or MRI data regarding ventricular morphology at the time of first or subsequent shunt obstruction may inform a clinician's judgement of shunt obstruction in later instances, but is not conclusive. In our series, we found that changes in morphology of the ventricular system in shunt obstruction were often, but not always consistent and predictable. It remains imperative, however, that cranial imaging performed to rule out shunt malfunction be compared to prior studies.

49. The British Antibiotic and Silver Impregnated Catheters for ventriculoperitoneal Shunts multi centre randomised controlled trial (The BASICS trial)

Presented by Christopher James Parks, MBBS

Conor L Mallucci, MBBS FRCS; Michael Jenkinson, MBBS; John Hartley, MBBS; Carrol Gamble, PhD; Helen Hickey, MBBS; Dyfrig Hughes, PhD; Michaela Blundell, MD; Tom Solomon, PhD (Liverpool, United Kingdom)

Introduction: Insertion of a ventriculoperitoneal shunt (VPS) for the treatment of hydrocephalus is one of the most common neurosurgical procedures, but failures because of infection occur in about 8% of primary cases and are responsible for major morbidity, prolonged hospital stay and significant health economic implications. There is no class 1 evidence for which shunt catheter type may reduce infection despite the arrival and large scale adoption of antibiotic and more recently silver impregnated catheters by neursourgeons.

Methods: BASICS is a national three-arm, multi-centre, phase III, randomised controlled trial comparing Bactiseal, Silverline and standard VPS in patients with hydrocephalus undergoing insertion of their first permanent shunt.1200 patients will be recruited from 17 regional neurosurgical units in the UK and Ireland. The study has opened in June 2013 and has begun recruiting.The primary outcome measure is time to VPS infection. Secondary outcome measures include time to VPS failure of any cause, reason for VPS failure (infection, mechanical failure, patient failure), types of bacterial VPS infection (organism type and antibiotic resistance) and incremental cost per VPS failure averted.

Results: Recruitment and trial progress and methods will be reported.In addition blood and CSF samples will be stored and used for research studies to characterise the blood and CSF patterns of host response, and to support the diagnosis of shunt infections and improved pathogen detection via an array of molecular methods including proteomics and transcriptomics.will be discussed.

Conclusions: This nationally funded mutli-centre study (£2.1 million) hopes to evaluate the clinical effectiveness and cost-effectiveness of antibiotic- and silver-impregnated catheters to reduce VPS infection. This is the first randomised controlled trial to compare these catheters with conventional non-impregnated silicone catheters. This study will generate one of the largest CSF and blood biobanks in a cohort of hydrocephalus patients.

50. Longitudinal post surgery DTI changes in children with hydrocephalus (HCP) and its predictive value for future behavioral outcome

Francesco T. Mangano, DO; Weihong Yuan, PhD; Stephanie Powell, PhD; Jannell Phillips, PhD; David Limbrick, MD, PhD; Joshua Shimony, MD; Mekibib Altaye, PhD; Robert McKinstry, MD; Scott Holland, PhD (Cincinnati, OH)

Introduction: DTI in white matter regions of HCP children is abnormal. No study has reported post-operative DTI and its predictive value related to behavioral outcome. We address these two issues with preliminary data.

Methods: Nine HCP children with DTI data at 3 and 12 month post-operatively were included (age at 3m follow-up: 3.12-19.39 month). Six of the 9 children were tested with Bayley Infant Scales of Development motor function (BISDm) at both time points. An additional child with only DTI data at 3m follow-up but BISDm at both time points was included. DTI data were acquired on 1.5 Tesla MRI using EPI sequences (TR/TE = 9400/93.2msec; resolution = 2.5mm iso, 15 directions, b=1000). Normal DTI range was calculated from data of our ongoing prospective longitudinal study. FA in the genu of corpus callosum (gCC) and posterior limb of internal capsule (PLIC) of controls were used in an exponential model and 95%predictive intervals defined the normal range. A normality index

was created with values of 1 or 0 according to FA being within or outside normal range. BISDm at 12m follow-up was used as outcome measure in the multiple regression analysis for the predictive value of FA (PLIC) at 3m follow-up.

Results: Eight patients had abnormal FA (PLIC) at 3m follow-up. At 12 months, the FA (PLIC) of 6/9 patients were in the normal range ($p<0.05$, Fisher's Exact Test, Two-tailed). No significant difference was found in gCC. Seven pts with BISDm at 3m and 12m showed a moderate correlation of scores ($R2=0.37$, $p=0.13$). Including the FA normality index in the regression analysis, showed that 79% of the variance seen in BISDm at 12m was accounted by the combination of motor scores and FA normality index at 3 month follow-up ($R2=0.79$, $p=0.04$).

Conclusions: We demonstrate a decrease in abnormal FA (PLIC) between 3m and 12m after surgery suggesting a trend of recovery. The FA at 3m accounted for the variance in motor scores at 12m follow-up, suggesting initial evidence for DTI's predictive value in neurologic outcome.

51. What is the Risk of Infecting a Cerebrospinal Fluid (CSF) Diverting Shunt with Tapping?

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Introduction: Most CSF diverting shunt systems have an access port. Tapping the shunt can yield valuable information as to its function and whether an infection is present. The fear of causing a shunt infection by tapping may limit the willingness to do so. This study investigates the risk of infecting a shunt with tapping.

Methods: Following IRB approval, CSF specimens obtained from tapping an indwelling CSF diverting shunt during the 2011 and 2012 calendar years were identified and matched with clinical information. A culture positive CSF sample was defined as an infection. If equivocal, such as a broth only positive culture, a repeat CSF specimen was examined. CSF was obtained by tapping the shunt access port with a 25-gauge butterfly needle after prepping the unshaven skin with Chlorhexidine.

Results: During the study period, 266 children underwent 542 shunt taps. With 541 taps no clinical evidence of a subsequent shunt infection was found. One child's CSF went from sterile to infected 15 days later; however, there was redness along the shunt tract for several days prior to the emergency room visit at the time of the initial sterile tap.

Conclusions: The risk of infection with tapping a shunt is remote if done correctly.

52. Reduction in Shunt Infection Rates by Applying Topical Antibiotics to Surgical Wounds Prior to Closure. A Comparison of One Surgeon's Experience Over Two Separate Five Year Periods.**

Joshua Marshall Beckman, MD; Lisa Tetreault, RN; Carolyn Carey, MD; Luis Rodriguez, MD; Gerald Tuite, MD (Tampa, FL)

Introduction: Minimizing infection is one of the principal outcome measures of any surgical implant procedure, including the placement of ventricular shunts. The application of antibiotic powder directly to surgical wounds during the implantation of deep brain stimulators, spinal instrumentation, and pacemakers has been associated with lower infection rates. However, no such study has been published regarding the efficacy of topical antibiotics during shunt surgery.

Methods: A retrospective chart review was performed for all patients who had a ventricular shunt operation performed by the same attending surgeon (GFT) between 2001 and 2012 at a single children's hospital. Patients were divided and compared between two different time periods: 2001-2005 (Group A) and 2008-2012 (Group B). The major difference in surgical protocol between these two time periods involved the application of Bacitracin powder directly to all surgical wounds in each patient in the latter group (B) with none receiving topical antibiotics in the earlier time period (Group A). The primary outcome measure was shunt infection within 90 days of surgery as defined by a positive csf culture, wound breakdown or pseudocyst formation.

Results: Of the 590 patients who underwent shunt surgery during this time period, infection occurred in 24/374 (6%) of patients in Group A (2001-2005) compared to 2/216 (1%) in Group B (2008-2012) ($p < 0.001$).

Conclusions: The direct application of Bacitracin antibiotic powder, as part of a standardized surgical shunt protocol, was associated with a significant reduction in shunt infections. Possible confounding variables will also be discussed.

53. Suprasellar pediatric craniopharyngioma resection via endonasal endoscopic approach**

Zarina S. Ali, MD; Shih-Shan Lang, MD; Ameet Kamat, MD; Nithin Adappa, MD; James Palmer, MD; Phillip Storm, MD; John Lee (Philadelphia, PA)

Introduction: Purely endoscopic endonasal approaches to surgical resection of pediatric suprasellar craniopharyngiomas are uncommonly performed. The aim of the study is to assess the feasibility and to describe the short-term outcomes of endonasal endoscopic approaches for the gross total resection of suprasellar craniopharyngiomas in the pediatric population.

Methods: A combined neurosurgical-otolaryngologic team performed gross total resection of craniopharyngiomas in seven pediatric patients (mean age 9.6 years) at The Children's Hospital of Philadelphia over 2011-2012. Short-term outcomes were analyzed over a mean follow-up period of 6.3 months.

Results: All tumors involved the sellar and/or suprasellar space and contained some cystic component. The mean maximal tumor diameter was 31.5 mm (range 18.5-62.0 mm). Using a bi-nostril approach, gross total tumor resection was obtained in all patients (100%). All patients with preoperative visual dysfunction demonstrated improvement in visual acuity. New or stable panhypopituitarism was observed in all cases. All patients developed postoperative diabetes insipidus and cerebrospinal fluid leak occurred in one patient (15%).

Conclusions: Complete radiographic resection of pediatric craniopharyngioma can be achieved via a purely endoscopic endonasal approach. In particular, this approach can be performed safely using the two-nostrils-four-hands technique with intraoperative neuronavigation. This approach should be highly considered in patients with progressive visual dysfunction. Further studies are needed to characterize the long-term surgical and clinical outcome of pediatric patients treated with this surgical approach.

54. Apparent Diffusion Coefficient Mapping in Medulloblastomas Predicts Non infiltrative Surgical Planes**

Neena Ishwari Marupudi, MD; Deniz Altinok, MD; Luis Goncalves, MD; Steven Ham, DO; Sandeep Sood, MD (Detroit, MI)

Introduction: Conventional magnetic-resonance-imaging (MRI) is essential in evaluation of pediatric posterior fossa tumors, but it still offers limited information regarding extent of tumor infiltration of adjacent critical structures. Because medulloblastomas demonstrate diffusion restriction on apparent diffusion coefficient map (ADC-map) sequences, we investigated whether diffusion restriction on the ADC-map can predict infiltration of the brain stem and cerebellar peduncles by medulloblastomas. Predicting the sites of infiltration can help define whether a surgical plane exists at the junction to critical structures; the information can influence the operative plan for the degree of resection of the medulloblastomas near critical structures. We hypothesized that diffusion restriction seen on the ADC-map can predict infiltration of the brainstem and/or cerebellar peduncles by medulloblastomas prior to surgery.

Methods: We performed a retrospective review of patients undergoing surgical resection of pathologically confirmed medulloblastomas. An experienced

pediatric neuroradiologist reviewed the MRIs/ADC-map, assessing the planes between the tumor and cerebellar peduncles/brainstem. An independent evaluator documented surgical findings from operative reports for comparison to the radiographic findings. We calculated sensitivity, specificity, positive predictive and negative predictive value of the ADC-maps to predict involvement of the right, middle, and left brainstem, as well as the right and left cerebellar peduncles.

Results: Thirty-four patients with medulloblastomas underwent surgical resection at our facility from 2004-2013; 27 patients met inclusion criteria (presence of appropriate imaging). Mean age at time of surgery was 8.2 ± 4.2 years. Positive predictive value of ADC-maps to predict tumor invasion of the brainstem and cerebellar peduncles ranged from 72.5% to 100%; negative predictive values ranged from 66.7-88.9%. Sensitivity approached 86% while specificity approached 84%. ROC-area ranged from 0.83 at the cerebellar peduncles to 0.81 at the brainstem.

Conclusions: ADC-maps are valuable in predicting the infiltrative and non-infiltrative planes along the tumor and brainstem interface in medulloblastomas. Inclusion and evaluation of ADC-maps in pre-operative evaluation may play a role in surgical resection planning, potentially influencing the surgeon's technical approach and how extensively the neurosurgeon may pursue a complete resection.

55. Risk of radiation induced malignancies from computerized tomography (CT) scanning in children shunted before 6 years of age

Daniel H. Fulkerson, MD FAANS; Ian White, MD; Kashif Shaikh, MD; Thomas Gianaris, MD (Indianapolis, IN)

Introduction: A number of mathematical modes predict an alarming risk of future cancer from the ionizing radiation exposure of computerized tomography (CT) scans. These studies compare an estimated tissue dose of radiation from phantom models to the known actuarial rate of cancer from populations exposed to radiation from other sources. Some models predict 29,000 future cancers and 14,500 deaths directly caused by 1 year's worth of CT scans in the United States. However, there is very little clinical data to justify these claims. In this study, we examine children who received a cerebrospinal fluid shunt before age 6. We chose a study period of 1991-2001 to allow at least 10 years of follow-up data.

Methods: We studied a cohort of 104 children. 62 of the children were shunted before 1 year of age. All patients in the study had at least 10 years of follow-up data. A retrospective chart review was performed to evaluate for any future head/neck tumor.

Results: The children received a total of 1584 CT scans over a follow-up period of 1622 person years. A total of 517 scans occurred prior to age 6, including 260 in the first year of life. There were zero subsequent benign tumors or radiation-induced malignancies in the study group.

Conclusions: Previously published models predict a significant number of future cancers directly caused by CT scans. However, there is very little correlative clinical data. In this study, zero future cancers were identified in a high-risk cohort. Future collaboration is needed to define the actual risk to patients.

56. The Emerging Role of Intra arterial Chemotherapy in the Management of Retinoblastoma: Safety, Efficacy, and Technical Aspects

Pascal Marcel Jabbour, MD, FAANS; Nohra Chalouhi; Stavropoula Tjoumakaris, MD; L Fernando Gonzalez, MD; Carol Shields, MD; Robert Rosenwasser, MD (Philadelphia, PA)

Introduction: Preliminary experience with intra-arterial chemotherapy (IAC) has shown promising results in the treatment of advanced retinoblastoma. Neurosurgeons have taken a central role in the treatment of this pediatric condition. The purpose of this study was to assess the safety and efficacy of IAC in a large, consecutive series of patients with advanced or medically refractory retinoblastoma.

Methods: A total of 200 IAC procedures were performed at Jefferson Hospital for Neuroscience between 2010 and 2013. Each patient was scheduled for 3 cycles of IAC at monthly intervals, and the number of cycles was based on the tumor response Our technique consists of catheterization of the ostium of the ophthalmic artery, followed by superselective injection of melphalan in a pulsatile fashion over 30 minutes. Data on procedural safety was prospectively collected.

Results: Several important technical and protocol refinements have been made over the study period to address evolving challenges. The technical success rate was 98%. There were only 2 technical complications in the series (1.0%): 1 internal carotid artery spasm during cannulation and 1 tiny infarct on magnetic resonance imaging. None of these complications were symptomatic or left permanent morbidity. There was no patient to develop retroperitoneal hematoma, acute limb ischemia, internal carotid artery dissection, or intracranial hemorrhage. With regard to ocular outcomes, only 12.8% of patients had to undergo enucleation. There were no instances of metastasis, secondary tumor, or death.

Conclusions: Intra-arterial chemotherapy is a novel technique in the management of retinoblastoma that provides high rates of globe salvage. Technical complications are benign and uncommon (1%). A proper operative technique is crucial to maximize the efficacy of chemotherapy and minimize its toxicity. Intra-arterial chemotherapy holds promise for thousands of infants and young children around the globe suffering from retinoblastoma.

57. Presentation, Management and Outcome of Intrinsic Cervicomedullary Tumors in Children

Joseph Hiram McAbee, BS; David Daniels, MD, PhD; Frederick Boop, MD; Atmaram Pai Panandiker, MD; Asim Choudhri, MD; Brent Orr, MD, PhD; Paul Klimo, Jr., MD, MPH (Winston-Salem, NC)

Introduction: Cervicomedullary tumors (CMT) represent a heterogeneous group of intrinsic brainstem tumors that are typically low-grade. They present with lower cranial nerve palsies and long-tract signs. Unlike diffuse pontine gliomas, CMT are associated with a relatively good prognosis. We review our experience with these tumors.

Methods: A single-institution retrospective review of all CMT patients treated between 1988-2013 was conducted with central review of radiology and histology. Survival and outcome after diagnosis were assessed.

Results: Thirty patients (17 boys, 13 girls) were identified. The median age at diagnosis was 6.5 years (range, 7 months-17 years) with mean follow-up of 5.9 years. Twenty-nine patients underwent surgical intervention (biopsy=9, GTR=4, NTR=1, STR=15). Fifty-three percent and 23% were diagnosed with grade I and grade II tumors, respectively. Five children received surgery alone (17%), while 12, 3, and 8 (40%, 10%, and 27%) received XRT, chemotherapy, or both, respectively. Five of six deaths were attributable to high grade tumors. Of the 24 children that are still alive, 88 percent enjoyed improvement of neurologic function following treatment.

Conclusions: Children with CMTs usually have low-grade pathology and long-term survival. Therapy should be directed at achieving local tumor control while preserving and restoring neurologic function. As such, we have demonstrated that radiation or chemotherapy following STR or biopsy can limit disease progression, improve symptoms, and result in long-term survival while avoiding the potential neurologic morbidity of radical resection.

58. Effect of Reoperation(s) on Recurrent Glioblastoma in Pediatric Patients

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Introduction: Glioblastoma carries a poor prognosis in pediatric patients. Debate exists as to the efficacy of additional surgical resection at the time of progression or recurrence, the aim of this study.

Methods: An IRB-approved retrospective analysis was performed on all children treated for pathologically confirmed glioblastoma at a single institution between 1986 and 2013.

Results: 45 children with glioblastoma (21 female) were identified. The median age at time of presentation was 9 years (range 0-20). Median duration of follow-up was 14 months (range 0-232). Patients who underwent gross total resection (16/45) had a median overall survival (OS) and progression free survival (PFS) of 87 (range 43-131) and 42 (range 0-108) months, respectively, whereas patients who underwent subtotal resection or biopsy had a median OS and PFS of 16 (range 11-22) and 4 (range 2-6) months, respectively (p=0.03, and p=0.023, respectively). 36 patients had radiographically confirmed progression or recurrence within the study period with a median time to recurrence of 4 months. 19/36 patients had reoperations: 12 patients had 2 resections, 4 patients had 3 resections, 2 patients had 4 resections, and 1 patient had 7resections. Patients who underwent reoperation upon recurrence had a median survival from time of recurrence of 14 months (range 1-28) and patients who did not undergo reoperation upon recurrence had a median survival from date of recurrence of 10 months (range 1-19, p=0.014). In multivariate analysis, accounting for age, gender, tumor location, extent of resection, chemotherapy, and radiation, reoperation upon recurrence was found to be significantly associated with increased survival from date of recurrence (p=0.017, n=33).

Conclusions: Extent of resection is significantly associated with increased OS and PFS. Re-resection upon recurrence of glioblastoma is associated with increased overall survival. Age at time of primary resection and gender were not found to be significant prognostic factors in patients with recurrent glioblastoma.

59. Predicting the Limits of the Endoscopic Endonasal Approach in Children: a Radiographic Anatomic Study

Philipp R. Aldana, MD, FAANS; Carl Youssef, BS; Dale Kraemer, PhD (Jacksonville, FL)

Introduction: The endoscopic endonasal approach (EEA) has been established as a viable alternate approach to craniovertebral junction (CVJ) pathology in adults. Our group has previously described the naso-axial line (NAxL) as an accurate predictor of the lower limit of the EEA to the CVJ in adults. The surgical anatomy affecting the EEA to the pediatric CVJ has not been well studied. Predicting the lower limit in various pediatric age groups is important in surgical planning. We used the NAxL to predict the EEA lower limit and examined the skull base anatomy affecting the EEA in children of different age groups.

Methods: Axial brain CT scans of 40 children with normal skull base anatomy were reconstructed sagitally. The following were plotted or measured: piriform aperture height (PAH), hard palate length (HPLe), NAxL, intersection of NAxL on C2 dorsal and ventral surface (C2D and C2V, respectively) and the distance of these from the hard palate line (HPL). Patients were divided into 4 groups, according to age (years): 3-6, 7-10, 11-14 and 15-18. A stepwise selection variable procedure was conducted to select the best fitted model for each outcome, using Corrected Akaike's information criterion.

Results: The NAxL predicted the lower limit of the EEA to be in the upper 1/3 of C2 in 26 patients and in the middle 1/3 in 13. In only one patient (13 y.o.) did the NAxL not intersect C2. The measurements of the inferior limits did not vary with age, varying between 9-11 mm below the HPL at C2V. PAH significantly predicted NAxL intersection at C2V and C2D (both p

Conclusions: PAH and HPLe are significant predictors of the NAxL and can affect the lower limit of the EEA. Using the NAxL as a predictor, the EEA will uniformly expose C2 in children, with the inferior limit ranging from the upper to middle 1/3of C2. Utilizing the NAxl preoperatively may help in planning the EEA to the CVJ in children.Here are your conclusions

60. Methotrexate Infusion Directly into the Fourth Ventricle in Children with Malignant Fourth Ventricular Brain Tumors: A Pilot Clinical Trial

David I. Sandberg, MD, FAANS; Soumen Khatua, MD; Michael Rytting, MD; Wafik Zaky, MD; Marcia Kerr, RN; Mary Tomaras, BS; Tiffany Butler, RN; Leena Ketonen, MD, PhD; Uma Kundu, MD; Bartlett Moore, PhD; Grace Yang (Houston, TX)

Introduction: Under an IRB-approved protocol, methotrexate was infused into the fourth ventricle in patients with recurrent malignant fourth ventricular tumors. We present preliminary results of this study, which marks the first report in humans of direct chemotherapy administration into the fourth ventricle.

Methods: Patients with recurrent, malignant tumors originating within the fourth ventricle underwent tumor resection and catheter placement into the fourth ventricle. The catheter was attached to an Ommaya reservoir. After confirmation of cerebrospinal fluid flow by CINE MRI, methotrexate was infused over 3 cycles, each consisting of 4 consecutive daily infusions (2 mg). Serum and cerebrospinal fluid (CSF) methotrexate levels and CSF cytology studies were obtained daily, and MRI scans of the brain and total spine were obtained after the 1st and 3rd cycle. Neuropsychological evaluation was performed before and after intraventricular chemotherapy.

Results: To date, 2 patients have each completed 3 cycles of therapy. Maximum serum methotrexate level was 0.08 micromoles/liter, and median trough CSF level was 22.27 micromoles/liter (range 0.53-212.36). Neither patient had any adverse events or even minor side effects. The first patient, a 19 year-old boy with recurrent medulloblastoma, had a partial response to therapy, with decreased tumor in the fourth ventricle and spine and fewer malignant cells on cytology analysis. The second patient, an 8 year-old boy with recurrent ependymoma, had stable disease. Neither patient had leukoencephalopathy on MRI scans.

Conclusions: Direct infusion of methotrexate into the fourth ventricle is safe and may represent a promising new means of treating recurrent malignant fourth ventricular brain tumors.

61. High Field Intra-Operative MRI - 4 Years Experience in Liverpool

Christopher James Parks, MBBS, FRCS(SN); Shivaram Avula, MD; Benedetta Pettorini, MD; Laurence Abernethy, MBBS; Conor Mallucci, MBBS (Manchester, United Kingdom)

Introduction: Due to acknowledgement that improved resection conveys improved prognosis, there is currently significant investment in the use of Intra-Operative MRI (ioMRI). Alder Hey Hospital in Liverpool has almost 4 years experience using this technology in over 130 paediatric tumour and epilepsy surgery cases. This has led to significant improvement in the service offered and other units new to this technology can learn from this experience.

Methods: In the ioMRI era, all patients have a scan when the surgeon feels that operative navigation needs updating or that resection is complete. In patients where no further surgery is necessary this becomes the post-operative imaging. Comparison is made with a historical cohort and a similar group of consecutive patients from a prospective database where complete surgical resection was the surgical intent. A separate group in whom subtotal resection was the pre-operative intent are also analysed. Demographics, imaging, pathology and surgical outcome are compared.

Results: Approximately 30% of patients underwent second-look surgery following ioMRI. No patients in the period since the introduction of ioMRI have required return to theatre within 6 months for repeat resection of residual disease. This compares to 14% in the historical cohort prior to availability of ioMRI.

Conclusions: Use of ioMRI has led to improvement in the service offered for tumour and epilepsy surgery in our unit. This is measured in eradication of

early return to theatre for residual disease but the extent of quality of service improvement is hard to quantify.

62. Withdrawn

63. POSTERIOR CALVARIAL EXPANSION USING CUSTOM MADE SPRINGS; THE EVOLUTION OF A SURGICAL TECHNIQUE.

Owase Jeelani; Richard Hayward (London, United Kingdom)

Introduction: The process of Calvarial Expansion has evolved over the past few decades, at our institution. Craniectomies and Biparietal expansions were the procedure of choice, followed by a Frontal Expansion and most recently a Posterior Calvarial Expansion. Posterior expansions were initially performed as large craniotomies with rigid fixation in an expanded position. This technique has gradually evolved with the use of springs acting as internal distractors and limited access approaches utilising endoscopes. We have done 56 cases in the past 3 years utilising the most recent technique and a total of 87 cases of PVE utilising springs. This paper aims to details the evolution behind this technique, the rational for the changes and expand on the surgical details of the current technique. The complications associated with this technique are presented as a separate paper.

Methods: The patient is positioned prone and a bicoronal incision is fashioned. The skin and muscle dissection ranges from turning the flap down to the Nuchal line and below for Foramen Magnum decompressions to limiting the flaps to 3-4 cm around the bicoronal incision and completing the lower bone cuts below the retromastoid region using limited access endoscopic techniques. The bone cuts are made vertex down to the retromastoid with a craniotome under direct vision Cuts are then made horizontally or vertically towards the foramen magnum using an endoscope or minimal access techniques. The bone is removed completely in one or two pieces and reattached and springs are then placed. In the recent technique the bone is not lifted off the dura but instead green stick fractured out before spring placement.

Results: Ophthalmic surveillance was used to monitor ICP and an improvement was seen in 89% of the cases. The complication rate was comparable to our traditional cohort. The surgical time and length of stay was shorter with a transfusion rate of 68% compared with 89% for the earlier cases

Conclusions: Limited access Posterior Vault Expansion using Springs is a safe, efficient and effective way of increasing the Calvarial Volume.

64. Efficacy Of Passive Helmet Therapy For Deformational Plagiocephaly: A Report of 1050 Cases

John Crantford, MD; Daniel Couture, MD; Aravind Somasundaram, BS; Claire Sanger, DO; Anne Argenta, MD; Lisa David, MD (Winston Salem, NC)

Introduction: There has been an increase in the incidence of children with deformational plagiocephaly (DP). The aim of this study was to assess the accuracy of the Argenta classification system (ACS) in defining a progressive degree of severity, identify an upper age limit for treatment, and determine the effectiveness of an inexpensive prefabricated helmet in managing DP.

Methods: An IRB-approved retrospective study was conducted on patients classified with the ACS for DP over a six-year period that were treated with a passive helmet, 1050 patients were identified. Inclusion criteria consisted of patients who were classified with Argenta II-V. Patients were categorized by severity level and age.

Results: Patients with Levels III-V required longer to correct when compared to patients with Level II (53%, 75%, and 81% longer, respectively (P<0.0001)). There was no statistically significant difference in the time to correction among the age categories, indicating that the previously believed upper time limit for correction may be inaccurate. An overall correction rate of 81.6 % to Class I was achieved irrespective of severity and degree, suggesting that an inexpensive molding helmet is highly effective. Patients treated with passive helmet therapy in the older group (<12 months) had an improvement in skull shape in the same time interval as the younger group (<3 months). Mean follow up was 6.3 months.

Conclusion: This study supports the use of passive helmet therapy for DP in infants from birth to 18 months of age and verifies the stratification of degree of deformity used in the ACS.

65. Multiple Direct Extracranial to Intracranial Bypass Procedures In Combination With Indirect Revascularization In Pediatric Moyamoya Angiopathy managed at the Moyamoya Center, University Children's Hospital Zurich, Switzerland.

Nadia Khan, MD; Dubravka Deanovic, MD; Martin Hoelzle, MD; Alfred Buck, MD; Gerasimos Baltsavias, MD; Annette Hackenberg, MD; Barbara Plecko, MD (Zurich, Switzerland)

Introduction: Childhood moyamoya is different to adult moyamoya. It is rapidly progressive showing frequent involvement of anterior and posterior cerebral circulation resulting in repetitive cerebral ischemia. Prevention of stroke is achieved by multiple cerebral revascularization procedures in the cerebral areas affected.

Material and Method: Twenty-three children with newly diagnosed moyamoya were managed at our moyamoya center (2011and 2013). Mean age at initial presentation was 6 years. Seventeen presented with bilateral symptomatic transient ischemic attacks. Twenty one children showed decrease perfusion reserves after Diamox challenge. Depending on the clinical symptomatology, the number of arterial territories involved on a 6-vessel cerebral angiography and the perfusion reserve deficits after a Diamox challenge on H215O-PET, surgery was tailormade to each individual child.

Results: Multiple cerebral revascularization procedures were performed in 21/23 patients. A total of 71 revascularization procedures were performed with 28 revascularizations in ACA (12 bilateral), 37 in MCA (17 bilateral) and 6 in PCA territories (all unilateral). Combined STA-MCA (superficial temporal artery to middle cerebral artery) bypass or STA-ACA (anterior cerebral artery) or OA-PCA (occipital artery to posterior cerebral artery) bypass was performed alongwith indirect encephalo-duro-periost-myo-synangiosis. In cases where a direct bypass could not be performed, indirect revascularization was undertaken. There were no peri- or postoperative complications.

Conclusions: Multiple tailormade direct bypass procedures in combination with indirect techniques for revascularization of the MCA, ACA and PCA territories are decisive in the prevention of stroke in moyamoya children. The presence of this angiopathy in non-Asian population is emphasized.

66. Cerebral Vascular Malformations in Pediatric Hereditary Hemorrhagic Telangiectasia

June Yowtak, MD, PhD; Michael Woodall, MD; Ian Heger, MD; James Gossage, MD; Cargill Alleyne, MD (North Augusta, SC)

Introduction: Hereditary Hemorrhagic Telangiectasia (HHT) is a hereditary disorder characterized by mucocutaneous telangiectasias, frequent nosebleeds, and visceral arteriovenous malformations. Although the systemic characteristics of HHT have been well studied, few reports have outlined the prevalence of the various cerebral vascular malformations found in pediatric patients diagnosed with HHT.

Methods: A retrospective review of a prospectively collected database of 167 pediatric patients (< 21 years of age at the time of referral) referred to our HHT center was performed. Data regarding history, physical examination, and radiographic studies were reviewed. Numbers and kinds of cerebral vascular malformations were tabulated with specific attention to characteristics and treatment of brain arteriovenous malformations (AVM).

Results: Seventy six patients (46%) were diagnosed with HHT by modified Curacao criteria out of the 167 pediatric patients referred for HHT evaluation. The average age at referral was 9.6 years (range 0.1-20.7 years). Screening MRI/MRA of the brain with contrast administration and gradient echo sequences were performed on 68 (89.5%) of these 76 patients. Cerebral vascular malformations were present in 11 (14.5%) patients. AVMs were identified in 7 (9.2%) patients, developmental venous anomalies in 2 (2.6%%) patients, cavernous malformation in 1 (1.3%) patient, and capillary telangiectasia in 1 (1.3%) patient. Five AVMs were Spetzler-Martin Grade 1, and two were Grade 2. Five AVM patients were treated with single modality therapy (embolization, surgery, or radiosurgery).

Conclusions: HHT patients are thought to have an increased risk of AVM formation as compared to the general population, but debate is ongoing regarding the natural history of these lesions in HHT patients. Current consensus guidelines call for MRI/MRA screening examinations of the brain in patients diagnosed with definite HHT by modified Curacao criteria. Given the small size and superficial location of HHT AVMs, single modality therapy appears to be a safe and efficacious treatment providing minimal morbidity and good patient outcomes. Further study is needed regarding the natural history of AVMs in HHT patients to guide treatment decisions.

67. Comparisons among prenatally predicted anatomical lesion level, actual anatomical lesion level, and early functional spinal level in myelomeningocele

Jeffrey Pugh, MD; Vanessa Rogers (Edmonton, Canada)

Introduction: Fetal MRI is becoming increasingly common in prenatal diagnosis of spina bifida and parental counselling. Clinicians incorporate data from fetal MRI for counselling prospective parents on their child's health, including functional motor ability; however, the predictive value of fetal MRI in this domain has not been well validated.

Methods: Thirty-five cases of prenatally diagnosed myelomeningocele were identified. Twenty of 35 were carried to term and followed postnatally. We conducted a retrospective review of 16 cases of myelomeningocele that underwent both fetal MRI and postnatal assessment. Predicted anatomical spinal lesion levels were recorded from fetal MRI radiology reports and compared to postnatal functional levels. Motor function was assigned a functional spinal level of L2 and higher, L3, L4, L5, or S1 and lower based on muscle strength testing.

Results: Across all lesion levels, 5/16 (31.3%) prenatally predicted levels exactly matched the functional motor levels. In the 11 cases where exact matches were not found, 2/11 (18.1%) had a functional outcome one level better than predicted, while 9/11 (81.8%) had a poorer functional outcome than predicted. Similar comparisons were made between postnatally determined anatomical lesion levels and functional motor levels. In total, 6/16 (37.5%) postnatally determined anatomical lesion levels exactly correlated with the functional motor levels. By anatomical lesion level, 2/2 (100%) matched in the L2 and higher group, as did 1/4 (25%) in L3, 1/5 (20%) in L4, 1/3 (33.3%) in L5, and 1/2 (50%) in S1 and lower. 1/10 (10%) non-matching cases had a better functional outcome than their anatomical level, while 9/10 (90%) non-matching cases had a poorer outcome. The correlation between prenatally predicted and actual anatomical lesion levels was 56.3% (9/16 cases), and all 16 cases exactly matched or were within one vertebral level.

Conclusions: The majority of patients with myelomeningocele do not perform at a functional level that exactly matches their predicted anatomical level. Based on our study population, when anatomical levels and functional motor levels do not match, the functional motor level is much more likely to be worse than the anatomical level.

68. Filum Terminale Lipomas: Imaging prevalence, natural history, and conus position

Cormac O. Maher, MD, FAANS; Michael Cools, MD; Hugh Garton, MD, MSC; Karin Muraszko, MD; Mohannad Ibrahim, MD; Wajd Al-Holou, MD (Ann Arbor, MI)

Introduction: Filum terminale lipomas (FTLs) are being identified with increasing frequency due to the increasing utilization of magnetic resonance imaging (MRI). FTL is associated with tethered cord syndrome (TCS) in some cases. The natural history of FTL as well as the conus position distribution in this population is not well-defined.

Methods: We searched the clinical and imaging records over a 14-year interval to identify patients with simple FTL. Those with lipomyelomeningocele or conus lipoma were excluded. In patients with a FTL, the clinical records were reviewed for indication for imaging, presenting symptoms, perceived need for surgery, conus position on MRI and clinical outcome. The conus level was directly assessed for 405 patients with available imaging, including 253 adults and 152 children. An equal number of age-matched controls were also examined for conus position. A natural history analysis was performed for 249 patients with greater than 6 months of clinical follow-up.

Results: 436 patients with FTL were identified. There were 217 males and 219 females. 282 (65%) were adults and 152 (35%) were children. Symptoms of TCS were present in 22 patients (5%). Fifty-two patients underwent surgery for FTL (11.9%). Sixty-four patients (16%) had a low-lying conus and 21 (5%) had a syrinx. In children, there is a clear difference in conus position between the FTL and normal groups, with a larger proportion of patients having a lower conus compared to controls ($p<0.0001$). Of the 249 patients included in the natural history analysis, only 1 patient developed new symptoms over a mean follow-up interval of 3.5 years.

Conclusions: FTLs are a common incidental finding on spinal MRI and most patients present without associated symptoms. The untreated natural history is generally benign for asymptomatic patients.

69. Conus Medularis Level in the vertebral column with transitional vertebrae.

Amir Kershenovich, MD; Oscar Malo-Macias, MD; Faiz Syed, MD; Joseph Lock, MD; Gregory Moore, MD, PhD (Danville, PA)

Introduction: The level of the conus medularis (CM) in the vertebral column has been studied widely as it has important clinical implications such as the diagnosis of tethered cord. The level of the CM has been observed to change when pathologies of the vertebral column or central nervous system are present, with higher levels found in scoliosis, kyphosis or achondroplasia, and lower levels in spinal dysraphism. Lumbar or sacral transitional vertebrae (LSTV) are common congenital spinal anomalies with a 4-30% prevalence in the population. The normal level of the CM in individuals with LSTV has not been determined and only one study describing 6 children with LSTV reported similar CM levels compared to another 94 children with normal vertebral columns.The aim of the study was to determine the average level of the CM in individuals of all ages with LSTV.

Methods: We performed a retrospective analysis of spinal MRIs of individuals of all ages with LSTV done in the Geisinger Health System between January 1st 2001 and December 31st of 2011. All ages, including in utero MRI for prenatal evaluation.

Results: We reviewed 1819 studies of patients with LSTV. 824 were analyzed as they met inclusion criteria.Mean age was 55.2 years old (range 1-97) with a media of 56.35 were children of 18 years old or less.468 subjects were found to have a lumbarized vertebra and 356 a sacralized vertebra.Most children 1-18 years old with a lumbarized vertebral had a conus medullaris at the level of L2, while those children with a sacralized vertebral had a clear tendency to have a higher CM at

T12-L1.For adults the observations was the same, most CM in lumbarized vertebra was lowers at L2, while for those with a sacralized vertebra it was at T12-L1.

Conclusions: The level of the conus medullaris in children and adults with LSTV is in general between T12 and L2, with lower conuses around L2 for those with a lumbarized vertebra and higher conuses around T12-L1 for those with a sacralized vertebra.

70. Withdrawn

71. Utility of Furosemide in Reducing Blood Transfusion in Sagittal Craniosynostosis Surgery

Adil Harroud; Alexander Weil, MD; Jean Turgeon, MD; Claude Mercier, MD; Louis Crevier, MD, MSC (St. Laurent, Canada)

Introduction: One of the major challenges in scaphocephaly correction surgery is the high postoperative transfusion rate related to blood loss in these small pediatric patients. We hypothesized that a significant proportion of postoperative anemia observed in these patients is actually dilutional. Consequently, since 2005, we have implemented a protocol of furosemide administration to treat "dilutional anemia" and prevent transfusion. The purpose of this study is to evaluate the impact of this protocol on the postoperative transfusion rate.

Methods: This is a retrospective study of 96 consecutive scaphocephaly patients operated at our institution between January 2000 and April 2012. Mean age at surgery was 4.9 ± 1.5 months (range: 2.8 - 8.7). Transfusion rates before (control group) and after (furosemide group) implementation of the protocol in 2005 were compared. The impact of furosemide administration on transfusion requirements was also measured while accounting for other variables of interest in a multiple logistic regression model.

Results: Patients gained on average 8.7% of their preoperative weight after surgery. The postoperative transfusion rate was significantly reduced in the furosemide group compared to the control group (18.3% vs. 50.0% respectively; p=0.003). The transfusion threshold remained similar throughout the study (60.9 g/L vs. 56.0 g/L for the furosemide and control groups respectively; p=0.085). The effect of furosemide administration on the probability of receiving a transfusion was evaluated in a multiple logistic regression model. Only furosemide administration significantly predicted the need for postoperative transfusion (OR=0.196, p=0.005).

Conclusions: Correction of the volemic status with furosemide administration significantly reduces postoperative transfusion requirements in patients with isolated scaphocephaly.

72. Disclosure of conflicts of interest in published pediatric neurosurgery research: How do we compare?

Patrick J. McDonald, MD FRCSC; Emma Schon, BS (Winnipeg, Canada)

Introduction: Many medical journals, including the Journal of Neurosurgery-Pediatrics (JNS-Peds) require voluntary disclosure of potential conflicts of interest (COI) and include any disclosure within the body of the published article. We reviewed COI disclosures in JNS-Peds in 2011 and 2013 and compared the incidence of COI disclosure in these two epochs with COI disclosure in the Journal of Neurosurgery (JNS) and the Journal of Neurosurgery-Spine (JNS-Spine).

Methods: The disclosure section in the JNS-Peds was reviewed in two epochs: January-June 2011 and January-June 2013.Disclosure was categorized under the following headings: not-for-profit grant or support (NFPG), industry grant (IG), other industry support (IS), industry consultant (C), Stock ownership (S), Royalties (R), Honoraria (H), Industry employee (E), Patents (P), and No disclosure (ND). All bnsidered Industry related disclosures. Results were compared with disclosure in JNS and JNS-Spine.

Results: 17 of 102 (17%) articles disclosed in 2011 and 26 of 112 (23%) in 2013. 6% and 8% of articles had industry related disclosures in 2011 and 2013 respectively, the majority being consulting fees in both epochs. 10% disclosed NFPG in 2011, with 14% in 2013. This contrasts with disclosure rates of 47% in JNS-Spine, the majority being industry related and 35% in JNS, a significant minority of which were industry related.

Conclusions: COI disclosure rates in JNS-Peds are lower when compared to JNS and JNS-Spine. Compared to other published neurosurgical research, industry related COI declarations are also lower.

Please note: *All abstracts are published as submitted by their authors. The AANS is unable to make any changes to abstract submissions.*

101. ADVERSE EVENTS ASSOCIATED WITH THE USE OF SPRINGS FOR MOVING CRANIAL BONE

Owase Jeelani; Roisin McNicholas; Richard Hayward (London, United Kingdom)

Introduction: The use of springs in craniofacial surgery was pioneered by Lauritzen in Gottenberg. We have found that they provide an efficient way of moving cranial bone for distances that were unachievable using previous methods that relied on holding mobilised bone stable by per-operative fixation; something of particular use in vault expansion procedures in which the amount of bone movement is severely restricted by the lack of immediate elasticity of the scalp. The purpose of this communication is to audit in more detail the incidence and clinical importance of those adverse events that can be attributed to the use of springs and point to ways in which their technology can, where possible be modified to improve their effectiveness.

Methods: All spring cases performed over the first 5 years of use were analysed using a comprehensive contemporaneously collated database.

Results: 1. Between 2008 and 2013 a total of 501 springs were inserted in 173 patients.

2. Their diagnoses/indications for operation were

   a. Sagittal synostosis - 77 (45%)
   b. Posterior vault expansion - 75 (43%)
   c. Other -23 (13%)

3. The average number of springs per patient has gone down steadily from 6 per patient in 2008 to 2 per patient since 2011, reflecting the learning curve.

4. Mean hospital stay of 2 nights

5. 38% of patients require a blood transfusion (the average red cell replacement was 40%).

6. Mean surgical time 75mins

7. 1 patient had a Grade 3 adverse event, 13% had a Grade 2 and 11% a Grade 1 adverse event. (see appendix)

8. 14% required an early removal of one/more springs

9. Morbidity due to aberrant/undesired bone movement by the springs was seen in 9% (n=17) cases. 53% of the cases were Sagittals, 35% PVE & 12% Other

Conclusions: This study confirms that the use of springs as a less invasive method for moving cranial bone with comparable morbidity compared with traditional techniques. Springs are a definite spring forward but "misdirection" of bone movement can be an issue.Use as few as possible per case.

102. Acetazolamide as a tool for surgical decision making in patients with arachnoid cysts and predictor of a good surgical outcome.

Amir Kershenovich, MD; Steven Toms, MD (Danville, PA)

Introduction: Arachnoid cysts (AC) are benign congenital malformations of the arachnoid with specific or nonspecific symptoms. The relatively frequent detection of AC in otherwise asymptomatic patients, despite neuroimaging signs of apparent increased intracranial pressure such as mass effect or bony erosion, has emphasized the current lack of reliable surgical indicators in a significant percentage of cases. We hypothesized that if symptoms caused by an AC are related to local pressure in the different anatomical structures of the brain, then medically reducing the amount of cerebrospinal-fluid (CSF) within the cyst or the whole system using Acetazolamide sodium, a carbonic anhydrase inhibitor known to reduce CSF production, would mimic surgical decompression of compressed areas and could serve as a decision making tool that neurosurgeons currently lack.

Methods: Retrospective chart review and analysis of 17 children and young adults who were evluated in clinic for an arachnoid cyst and possible related symptoms, who were treated / challenged with oral Acetazolamide for 2-4 weeks. Fifteen had improvement or resolution of their symptoms and thus, surgical cyst content diversion was offered and performed.

Results: Of the 15 patients who underwent surgical intervention, complete persistent symptom resolution up to the last follow up occurred in 12 patients (80%); another patient had recurrence of the symptoms 4 months after surgery and two patients reported improved symptos after surgery.

Conclusions: Improvement or resolution of potentially associated symptoms to arachnoid cysts after preoperative treatment with oral Acetazolamide seems to be predictive of a good outcome after surgical diversion of the cyst content.

103. Acute Spinal Cord Injury with Associated Chiari I Malformation

Krystal Lynne Tomei, MD, MPH; Ruth Bristol, MD; David Shafron, MD; Ratan Bhardwaj, MD, PhD; P David Adelson, MD (Phoenix, AZ)

Introduction: Since Chiari I malformations (CIM) involve descent of the cerebellar tonsils through the foramen magnum causing obstruction of cerebrospinal outflow and brainstem compression, patients often present with headache, lower cranial nerve dysfunction, hydrocephalus and syrinx. CIM have rarely been associated with acute spinal cord injury (SCI), most commonly with associated syringomyelia with only individual case reports of SCI in the absence of a syrinx.

Methods: We report a retrospective series of children who presented with acute SCI with CIM without syringomyelia from 7/1/10 through 7/1/13, reviewing history for trauma, acute presentation, diagnostic imaging including MRI findings, management, and recovery.

Results: Seven patients were identified with CIM and acute SCI without syringomyelia. Only one patient did not have a history of trauma. Imaging findings included: tonsillar descent ranging from 5-16 mm, and spinal cord edema in five patients extending into high thoracic levels. Two patients recovered fully, four patients partially recovered, and one child had no recovery of function (C2 ASIA-A). No patient had syringomyelia upon presentation or even on follow up imaging post injury. Three children underwent immediate decompression, while three children who presented in a delayed fashion are pending decompression, and one refused surgery.

Conclusions: CIM carries a small but present risk of severe SCI with even minor trauma, even in the absence of syringomyelia. Our patients demonstrated variable and often incomplete recovery, suggesting that counseling of patients with CIM found incidentally should include the risk of SCI with minor craniocervical trauma.

104. An Investigation of Primary Osseous Tumors of the Pediatric Spine

Thomas D. Dieringer; Yasser Jeelani, MD; Stephanie Da Silva, BA; Mark Krieger, MD; J. Gordon McComb, MD (Buffalo, NY)

Introduction: The purpose of this study was to retrospectively review the diagnosis, management and outcome of primary osseous spine tumors in a pediatric population.

Methods: With IRB approval, the medical records of patients diagnosed and surgically treated with primary bone tumors at a single institution from 1997-2013 were retrospectively reviewed.

Results: Thirty-nine patients were identified with the histology being as follows: 15 aneurysmal bone cyst (ABC), 6 osteochondroma, 4 eosinophilic granuloma, 4 osteoblastoma, 3 Ewing's sarcoma, 2 giant cell tumor, 2 osteoid osteoma, 1 osteoma, 1 hemangioma, and 1 fibrous dysplasia. Presenting symptoms were: pain

(34/39), musculoskeletal issues (30/39), and neurological deficit (17/39). All patients underwent surgical intervention of whom 26/39 had a gross total tumor removal and 13/39 a partial removal. Nine patients had a recurrence of their tumor, 4 following gross total removal and 5 after partial (4/9 being ABC) and 8/9 patients had repeat operative resection. Two patients received chemotherapy following primary resection, 2 radiation following recurrence and 1 both after tumor progression. The mean and median follow-up time was 157 and 129 weeks respectively. Instrumentation for stabilization was required in 22/39 patients including all 15 with ABC. At the conclusion of the study, 1 patient died and 3 were lost to follow-up. Eleven (11/35) were free of disease and no residual deficits, 23/35 had stable disease with a degree of morbidity and 1/35 with progressive disease.

Conclusions: Most primary bone tumors are histologically non-malignant and respond well to excision, but often require stabilization with instrumentation.

105. Analysis of Cervical Spine Imaging in Pediatric Trauma Patients

Carolyn Sue Quinsey, MD; Patricia Dias, BS; Scott Elton, MD; Deb Bhowmick, MD (Chapel Hill, NC)

Introduction: There does not exist a consensus protocol for diagnostic imaging in pediatric cervical spine clearance. This study characterizes the past practices at UNC in order to develop a protocol for pediatric trauma that will standardize cervical imaging, reduce radiation and time in a collar, and quickly identify injuries.

Methods: Children ages 0-18 from 2002-2012 evaluated at University North Carolina Chapel Hill were included by retrospective review using the institutional pediatric trauma registry. Radiographic and clinical methods of cervical spine clearance, and time to clearance were recorded.

Results: A total of 1230 pediatric trauma patients admitted to UNC in the study period required cervical spine clearance, and 52 cervical injuries were identified. Screening modalities included plain radiographs (61%), CT (29.6%), and no imaging (9.4%). Clinical clearance was used in 85%, and clearance based on negative imaging and low suspicion in 8.9%, and MRI in 2.9% patients. Average time in a cervical collar was 1.4 days. High velocity traumas were more likely to have CT as an initial imaging study (78%), and fall from <5 ft and age <6 were more likely to have x-ray as initial imaging study (89%).

Conclusions: The clinical context and radiographic studies were combined to safely clear the cervical spine of patients at UNC, however this was not done in a uniform manner. The data from this study will be used to adhere to a pediatric cervical clearance protocol providing consistency and best practice in the care of pediatric trauma patients.

106. Anterior Cranial Vault Reconstruction for Metopic Craniosynostosis

Andrew Hoey; Benjamin Carson Sr., MD; Amir Dorafshar (Newbury, United Kingdom)

Introduction: Craniosynostosis is a congenital defect in which one or more of the cranial sutures close prematurely, therefore changing the growth pattern of the skull. Worldwide it affects 1 in 2000 to 2500 live births each year. Despite being a known condition for centuries, modern surgical management has only developed over the past 100 years. Success of surgery is dependent on the recognition and understanding of the growth of the skull during infancy and childhood.

Methods: Here we describe the anterior cranial vault reconstruction of an 8-month-old baby boy who presented with trigonocephaly due to metopic craniosynostosis.

Results: The patient made an excellent postoperative recovery and was discharged 5 days after the surgery. He was reviewed in clinic 2 weeks later demonstrating a much-reduced frontal angulation and an improvement of the appearance of the cranial vault.

Conclusions: The premature closure of cranial sutures results in the skull failing to grow at an appropriate rate to match that of the brain. As a result, the growing brain puts additional pressure on the surrounding malleable neonatal calvarium, resulting in an associated cranial deformity. Therefore, the primary goal of surgery is to restore the normal shape of the skull. This is achieved by the removal of the prematuraly fused sutures and reconstruction of the affected parts of the skull, which results in an aesthetic improvement to the appearance of the child's head.

107. Are pre-operative laboratory investigations and cross-match necessary for elective pediatric neurosurgical case management?

Ashutosh Singhal, MD, FRCSC; Michael Yang; Alexander Hengel, BS; Nicholas Au, MD (Vancouver, Canada)

Introduction: Studies in the adult literature suggest preoperative laboratory investigations and cross-match are excessively performed and often do not lead to change in clinical management. The purpose of this study was: 1. explore whether preoperative laboratory investigations in children alter clinical management, and 2. determine the utilization of cross-matched blood intraoperatively in elective pediatric neurosurgical cases.

Methods: We reviewed pediatric patient charts for elective neurosurgery procedures (2010-2012) at BC Children's Hospital. Variables collected include pre- and postoperative complete blood count (CBC), electrolytes, coagulation, group and screen, and cross-match. The review also examined for altered clinical management, as a consequence of pre-operative blood work. The number of cross-matched blood units, transfused intraoperatively, was also obtained.

Results: 212 patients were reviewed. Pre-operative CBC was done on 138 and 41% were abnormal. Coagulation bloodwork was performed in 111 patients and 25% were abnormal. Out of all the pre-op lab investigations, only 2 patients (both previously on chemotherapy) had lab values in the critical range. Apart from these 2 patients with critical lab values, the bloodwork did not alter clinical management. 65% of patients had a group and screen and 60% had blood cross-matched; 6% of patients (12/212) received intraoperative blood transfusion (66% of these patients were under 3 years of age).

Conclusions: This study suggests that the results of pre-operative laboratory exams have limited or no value, apart from cases with oncology and pre-existing conditions. Additionally, there is a need to further refine who receives cross-matching to avoid increased costs and patient discomfort.

108. Withdrawn

109. Assessing the optimal timing of radiation therapy for primary spinal cord tumors

Ganesh Mani Shankar, MD; Torunn Yock, MD; Shannon MacDonald, MD; Nancy Tarbell, MD; Ann-Christine Duhaime, MD (Boston, MA)

Introduction: Primary spinal cord tumors are rare; thus, consensus for management and the role of adjuvant therapy remain unclear. To minimize late complications, prior series suggest that radiation therapy (RT) can be deferred until tumor progression. We report our experience at MGH with proton RT to test this observation.

Methods: This retrospective study reviewed patients< age 21 with spinal cord astrocytomas (n=9) or ependymomas (n=17)referred for RT from 1991-2010. Progression was defined as the first radiographic recurrence. Timing of radiation was defined as delayed if administered at least 6 months following resection or following radiographic progression.

Results: Median age at diagnosis was 7.4 years for astrocytomas and 11.2 years for ependymomas. Near- or gross-total resections were achieved on 10/17 ependymomas and 2/9 astrocytomas. All astrocytomas and 16/17 ependymomas received proton therapy. RT was delayed in 7/16 patients with ependymoma (grade I), and 5/9 with astrocytoma. Ependymoma progression-free survival for grades I, II, and III was 8.0, 2.4, and 2.0 years, and for astrocytoma was 4.6, 4.2, and 3.7 years. No astrocytoma treated with delayed RT demonstrated progression during follow-up, while 3/7 ependymomas progressed after delayed RT.

Conclusions: This study confirms prior observations that adjuvant proton RT for spinal cord astrocytomas appears to stabilize disease when initiated after progression, but suggests that low-grade ependymomas can progress after delayed RT. Substantiating these findings through a larger multicenter study including multivariate analysis will be important to ensure patients achieve therapeutic benefit from RT while balancing potential risks of the intervention.

110. Association Between Myelomeningocele and HIV Positivity in Sub-Saharan Africa - The Chicken or the Egg?

Ramin Eskandari, MD; Jay Riva-Cambrin, MD, MSC; John Mugamba, MD; Peter Ssenyonga, MD; Kenneth McIntosh, MD; Benjamin Warf, MD (Mountain View, CA)

Introduction: Human Immunodeficiency Virus (HIV) infection continues to be prevalent albeit decreasing in Sub-Saharan Africa. A previous smaller study from Uganda suggested hydrocephalic infants presenting with myelomeningocele were more likely to be HIV-positive than those with other etiologies. We hypothesized that myelomeningocele infants carry higher risk for vertical HIV transmission.

Methods: A retrospective cohort study was conducted by reviewing medical records of all patients admitted to CURE Children's Hospital of Uganda (CCHU) between December, 2000 - March, 2013. Our independent variable-of-interest was open myelomeningocele at presentation. The outcome was HIV serum-positivity measured by three separate confirmatory antibody tests. The multivariate regression model was adjusted for age, diagnosis, sex, presence of hydrocephalus and country of origin.

Results: Of 8266 patients, 6586 were included for final analysis and 218 were HIV-positive (3.3%). Myelomeningocele patients had 4.7% HIV-positivity compared to 2.9% (other diagnoses $p<0.001$). Multivariate analysis showed only myelomeningocele diagnosis was an independent risk factor for HIV-positivity (OR=1.79,CI[1.1,2.9]). After patients were stratified for age, HIV-positivity was significantly higher in infants with myelomeningocele aged 1-3 months (8.0% versus 3.6% respectively,p=0.01), 6-12 months (7.7% versus 2.0% respectively,p=0.03), but not in patients 0-1 month, 3-6 months and greater than 12 months.

Conclusions: We identified an almost doubling of HIV rates in infants with myelomeningocele presenting to CCHU. Whether maternal HIV infection increases risk for neural tube defects, or having a myelomeningocele increases the risk for maternal transmission of HIV needs further study.

111. Association of Chiari I Malformation with Loss of Gag Reflex

Brandon G. Rocque, MD; Elias Rizk, MD; R Tubbs, PhD; W Oakes, MD (Birmingham, AL)

Introduction: While the most common presenting signs/symptoms of Chiari I malformation are headache and scoliosis, a small proportion of patients present with cranial nerve abnormalities, including hoarseness or dysphagia. A formal assessment of the gag reflex in Chiari I patients has not been performed.

Methods: We a prospectively evaluated the gag reflex in all patients with Chiari I malformation evaluated in our Chiari clinic. Gag reflex was tested by stimulating the oropharynx with a cotton swab. Reflex was classified as normal or abnormal. We also measured tonsillar descent, presence of syrinx, and location of syrinx.

Results: We evaluated 25 patients with Chiari I. Gag reflex was present in 14, absent in 9, and diminished in 3. Mean tonsillar descent was 13mm below the foramen magnum. There was no association of degree of tonsillar descent with gag reflex. Of 10 patients with a syrinx, 8 had absent or diminished gag reflex. In contrast, gag reflex was normal in 11 of 15 patients without a syrinx. This association was statistically significant (p=0.015). We found no association between the size or location of the syrinx and gag reflex.

Conclusion: This study finds a strong correlation between the absence of the gag reflex and the presence of a syrinx in patients with Chiari I malformation. This may indicate that there is under-appreciated brainstem or cranial nerve dysfunction in these patients. Further work is ongoing to investigate the effect of Chiari decompression on the gag reflex.

112. Atlantoaxial Fusion in the Pediatric Population: Risk Factors for Fusion Failure

Walavan Sivakumar, MD; Marcus Mazur, MD; Jay Riva-Cambrin, MD; Jaes Jones; Douglas Brockmeyer, MD (Salt Lake City, UT)

Introduction: Posterior atlantoaxial arthrodesis in the pediatric population is typically reserved for instability secondary to a traumatic or congenital etiology. Few studies report risk factors for fusion failure in these patients.

Methods: Clinical and radiographic data were retrospectively double-reviewed in pediatric patients undergoing atlantoaxial fusion at Primary Children's Medical Center from 1995-2013 to identify risk factors for fusion failure, as defined by the need for reoperation. The following clinical data were obtained: patient demographics, etiology of atlantoaxial instability, details of surgery (C2 fixation, side of screw placement, use of biologic adjuncts, type and location of bone graft, and incidence of postoperative bracing), clinical outcomes, and incidence of reoperation. Independent correlations between each variable and the need for reoperation were assessed with univariate and multivariate logistic regression analysis.

Results: Of the 50 patients included (Os odontoideum (Os)=30, Trauma=7, Rotatory subluxation=5, Down syndrome(DS)=4, Skeletal dysplasia=2, Rheumatologic=1, Tumor=1, four required reoperation for a nonunion (Os=3, DS=1). Univariate analysis showed that patients with an intraoperative complication had a significant association with fusion failure, requiring a revision arthrodesis (p=0.0006). This association lost significance in the multivariate analysis. Patients who received allograft had a higher failure rate with a trend toward significance after both univariate (p=0.08) and multivariate analyses (p=0.06, OR 11.1, CI [0.90,142.9]). Etiology of instability, the use of unilateral or bilateral constructs, type of C2 fixation, and use of BMP were not associated with fusion failure.

Conclusions: The use of allograft in atlantoaxial fusion for pediatric atlantoaxial instability is associated with higher failure rates.

113. Atypical teratoid / rhabdoid tumor of the central nervous system: The Miami Children's Experience

Alexander Gregory Weil, MD; Alexander Weil, MD; Joanna Gernsback, MD; Ana Diaz-Martin, RN; John Ragheb, MD; Toba Niazi, MD; Sanjiv Bhatia, MD (Miami, FL)

Introduction: Atypical teratoid / rhabdoid tumor (AT/RT) of the central nervous system (CNS) are rare, agressive neoplasms associated with a dismal prognosis. We sought to assess a single institutional experience and survival rate with emphasis on the impact of radiation therapy before 3 years of age.

Methods: Retrospective chart review of 10 patients treated at Miami Children's Hospital (MCH).

Results: Over six years (2006-2012), 10 patients with a mean age of 23 months were treated at MCH for AT/RT of the CNS.One patient underwent biopsy followed by gross total resection (GTR), 6 underwent GTR, and 3

underwent subtotal resection. Seven patients (7/10) had associated obstructive hydrocephalus. Adjuvant alkaloid-based chemotherapy was used in all 10 patients. Six underwent high-dose chemotherapy with stem cell transplantation protocol. The remaining 4 patients underwent different protocols of adjuvant alkaloid-based chemotherapy. One patient died prematurely from chemotherapy toxicity, and the remaining 9 patients received different regimens of radiation therapy, including proton beam therapy in 2/9. Of the 8 patients receiving adjuvant radiation therapy, 4 were under 3 years old (y.o) and 4 were over 3. A total of 5 (4/5 patients were under 3 y.o at diagnosis) patients were alive with a median follow-up of 6.7 years after diagnosis.

Conclusions: AT/RT of the CNS is an aggressive malignant tumor with a very poor prognosis. AT/RT remains a difficult pathology to treat due to being only recently recognized with very few randomized trials in place and changing but not agreed upon standardized treatment protocols. In our review, radiation therapy before 3 years of age aided in prolonging prognosis, however radiation-induced morbidity was associated with neurocognitive impairment as has been previously documented.

114. Withdrawn

115. Best Neurosurgical Matrix for Youth with a Neurosurgical Condition and Their Family: Quality Improvement Model

Hector E. James, MD, FAANS(L); Marc James, MBA (Jacksonville, FL)

Introduction: This report addresses a pediatric neurosurgery healthcare process sequence in providing an efficient and caring environment for youth with a neurosurgical condition and their families.

Methods: In reporting patient care outcomes, the existing neurosurgical literature emphasizes results of operative interventions, but the healthcare environment related to interventions is commonly not addressed. Matrix Organization is a mixed form of environment in which traditional hierarchy is overlaid by some form of lateral authorization, influence or communication.1

Results: Creation and development of a pediatric healthcare matrix organization structure will be described, emphasizing the difference between vertical models to horizontal models. The approach and establishment of process sequencing with a faculty matrix, administrative matrix and allied health matrix to provide a shared patient care vision will be presented. Techniques employed to develop the human resources to create the best pediatric neurosurgery team by assigning specific responsibilities to the individual team members and creating a matrix mind2 will be provided.

Conclusions: By giving a consistent healthcare delivery sequence for the child and the parents/caregivers, the disruptive price of inconsistency is minimized. The matrix model experience has been very useful in dealing with relationship and communication with other specialties and allied health personnel the child and family/caregivers encounter throughout the hospital stay.

References: Kuprenas JA. Implementation and performance of a matrix organization structure. International Journal of Project Management 2003;21:51-62. Bartlett CA, Ghoshal S. Matrix management: Not a structure, a frame of mind. Harvard Business Review 1990, July-Aug:2-8.

116. Bilateral Hemicraniectomy in the Management of Diffuse Cerebral Edema

John Lawrence Gillick, MD; Dhruve Jeevan, MD; Jayson Neil, MD; Avinash Mohan, MD; Michael Tobias, MD (Valhalla, NY)

Introduction: The use of decompressive hemicraniectomy in the pediatric population has been established as a surgical option in managing intractable intracranial hypertension (IC-HTN). However, in the setting of diffuse cerebral edema, the laterality of the procedure may be difficult to decide. Little has been published regarding the use of a bilateral hemicraniectomy. We present 2 cases in which this procedure was used.

Methods: A retrospective review was performed of 2 patients who underwent bilateral hemicraniectomy for medically intractable IC-HTN. Their Glasgow Outcome Scales (GOS) at 3 months and 6 months were observed.

Results: A 16 year-old boy who was struck by a truck while riding his skateboard had diffuse cerebral edema and a posterior fossa epidural hematoma (EDH) on imaging. He underwent a suboccipital craniectomy and EDH evacuation. However, the patient had persistent IC-HTN. Given the imaging finding of diffuse cerebral edema, he underwent a bilateral hemicraniectomy. His GOS at 3 and 6 months was 5. An 11 year-old female was struck in the head by a falling tree branch. A head CT showed diffuse cerebral edema and bifrontal contusions. She underwent bilateral hemicraniectomy given no discreet focus of mass effect on imaging. Her GOS at 3 months and 6 months was 5.

Conclusions: The treatment of IC-HTN in the pediatric population can be challenging in cases of diffuse cerebral edema with no focus of mass effect. We present an alternative surgical option that may address this pathology.

117. Bone Morphogenic Protein in Pediatric Spinal Fusion: prevalence and complications

Brandon G. Rocque, MD; Mick Kelly, BS; Joseph Miller, MD; Paul Anderson, MD, MS (Birmingham, AL)

Introduction: Use of recombinant human bone morphogenic protein-2 (BMP) in children has not been approved by the FDA. Age under 18 or lack of evidence of epiphyseal closure are considered contraindications to BMP use by the manufacturer. We performed a query of the database of one of the nation's largest health insurance companies to determine the rate of BMP use and complications in pediatric patients undergoing spinal fusion.

Methods: We utilized PearlDiver Technologies database containing all records from United Healthcare from 2005 to 2011 to query all cases of pediatric spinal fusion with or without BMP use.

Results: 4658 patients underwent spinal fusion. The majority was female (65.4%); the vast majority was age 10-19 (94.98%) and underwent thoracolumbar fusion (93.13%). BMP was used in 1752 (37.61%) spinal fusions. There was no difference in the rate of BMP use comparing male to female or age greater versus less than 10. Anterior cervical fusions were significantly less likely to use BMP (7.25%). Complications occurred in 9.82% of patients with BMP vs. 9.88% of patients without BMP. Complication rate was nearly identical in male vs. female patients and in patients older vs. younger than 10. Comparison of systemic, wound-related, CNS, and other complications showed no difference between groups with and without BMP. Reoperation rate was also identical.

Conclusion: BMP is used in a higher than expected percentage of pediatric spinal fusions. The rate of complications in these operations does not appear to be different with versus without BMP.

118. C2 Spondylolysis in Very Young Children 3 Years of Age or Less: Clinical Presentation, Radiographic Findings, Management, and Outcomes with a Minimum 12 Month Followup

Sudhakar Vadivelu, DO; Steve Hwang, MD; Dan Fulkerson, MD; Tom Luerssen, MD; Andrew Jea, MD (Houston, TX)

Introduction: Cervical spondylolysis is an uncommon disease involving a defect at the pars interarticularis. It is most frequently found at the C6 level. Its clinical presentations range from incidental radiographic findings to neck pain, and rarely, neurological deficits. Subaxial cervical spondylolysis has been described in 150 patients, while C2 spondylolysis has been infrequently reported in 24 pediatric and adult patients. There is great interest in the long-term followup of very young children with this spine disorder; however, only a few longitudinal studies exist.

Methods: We reviewed 6 cases of bilateral C2 spondylolysis at Texas Children's Hospital and Riley Children's Hospital; this was combined with 4 other cases in the literature, yielding a total of 10 patients. Data regarding the patients' age, sex, odontoid angulation and displacement, associated spine anomalies, neurological deficits, treatment, and most recent followup were recorded.

Results: The patients' ages ranged from 3 to 36 months (mean 11.8 months). The boy:girl ratio was 6:4. The pattern of the odontoid deformity was reported or could be measured for 10 patients. The odontoid was displaced a mean of 1.05 mm, and the odontoid was angulated a mean of 15.5 degrees. Dynamic radiographs showed an average of 1.37 mm of movement of C2 on C3 (range, 0 - 9 mm). Spinal cord injury was noted in 1 patient. Out of the 10 patients, 9 were treated initially with conservative therapy, including 2 with close observation alone, 6 with rigid cervical collar, and 1 with halo-vest immobilization. Two needed eventual surgical treatment with posterior instrumented fusion for progressive deformity of the odontoid and neurological deficit.

Conclusions: Based on the literature and our own experience, we conclude that most very young children with C2 spondylolysis remain neurologically intact and maintain stability despite the bony defect in long-term followup, and may be managed conservatively. Surgery is reserved for patients with severe instability or spinal cord compromise secondary to stenosis and local C2 kyphosis.

119. CSF and Spinal Cord Velociy Quantification During Acute Syrinx Formation in Chiari I Malformation

Tsulee Chen, MD; Mikayla Lowenkamp; Shaffer Nick; Jenna Landes; Bryn Martin, PhD (Akron, OH)

Introduction: Time course for syrinx formation in Chiari I malformation is reported to gradually progress over years. Usually Chiari and syrinx are discovered at the time of diagnosis, but we present a case documenting syrinx formation over the course of 1 week in an incidentally found Chiari I malformation in the setting of viral meningitis. We then measured velocities at three different time points in six different areas to evaluate for implications on the pathophysiology of syrinx formation.

Methods: We present a 16 year old diagnosed with viral meningitis, and on imaging studies was found to have hydrocephalus and a Chiari I malformation. Velocity measurements were obtained at three time-points: TPa) initial presentation, TPb) 4 days after presentation with syrinx formation, and TPc) 3 days after surgical treatment. CSF velocities were measured within six regions of interest (ROI) 1) cerebral aqueduct, 2) 4th ventricle, 3) subarachnoid space ventral to the spinal cord, 4) obex, 5) cervicomedullary spinal cord, and 6) prepontine cistern. We used a custom Matlab program to select pixels within each ROI and record their individual velocity waveforms for comparison.

Results: Results show that CSF velocities did not significantly change between the ROIs for the 3 time points, except for the spinal cord. Cord velocity decreased significantly after surgery.

Conclusion: In our case, these results support that surgical decompression resulted in a significant decrease in spinal cord velocity. This finding may have implications of the involvement of spinal cord movement in syrinx formation in the setting of Chiari I malformation.

120. CUBE MRI Characteristics as a Determinant for Endoscopic Third Ventriculostomy Success

Mark Calayag, MD; Alexandra Paul, MD; Matthew Adamo, MD (Albany, NY)

Introduction: The CUBE MRI sequence is currently being used to evaluate the patency of endoscopic third ventriculostomies(ETV). However, there have been no studies examining whether a CUBE MRI can predict future success of an ETV. The goal of this study was to determine if certain flow characteristics on CUBE MRIs could prognosticate the success or failure of an ETV

Methods: We retrospectively reviewed all patients that underwent an ETV between 2009 and 2013, and had a CUBE MRI within one month post-operatively. Baseline demographics were recorded as well as the volume of flow in the third ventricle, the maximum and minimum width of flow on the mid-sagittal view, and whether the ETV had failed. Furthermore, we devised a grading system to categorize flow by the width of the signal within the third ventricle.

Results: 17 patients were identified. The average minimum width of ETVs that failed was 1.3 mm (versus 3.4 mm in successful ETV's) which was found to be significant ($p = 0.04$). Also, the majority of ETVs that failed (67%) were classified as Grade 1 or narrow flow.

Conclusions: Our study suggests that immediate post-operative CUBE studies may have some value in predicting whether an ETV will require future intervention. This may alter how closely clinicians will monitor patients in the follow-up period. However, this was a small retrospective series and a larger, prospective study would be required to further elucidate this.

121. Cerebrospinal Fluid Diversion and Outcome in Childhood Intracranial Ependymoma

Jamies Rawson; Yasser Jeelani, MD; Stephanie Da Silva, BA; Floyd Gilles, MD; J. Gordon McComb, MD; Mark Krieger, MD (Berwyn, IL)

Introduction: Ependymomas make up 10% of intracranial tumors in children and are associated with poor outcomes. Half of these patients present with hydrocephalus and many require permanent cerebrospinal fluid (CSF) diversion but factors that predict this need are unclear. Prognostic factors of patient survival are likewise ill-defined hindering optimal therapy selection. We attempted to identify prognosticators for CSF diversion and patient survival in hopes of improving management of childhood intracranial ependymoma.

Methods: An IRB-approved retrospective chart review was performed on all patients who underwent surgical resection of intracranial ependymoma at our institution since 2003. Examined variables included: patient age, duration of symptoms, hydrocephalus, tumor grade, location, degree of surgical resection, placement and duration of externalized ventricular drain, and presence of postoperative shunt. Mean follow-up time was 4.6 years.

Results: 46 patients were identified. Patients who required a permanent CSF shunt were significantly younger (4 vs. 8 years, $p<0.001$), had a shorter duration of symptoms (34 vs. 127 days, $p=0.06$), and were more likely to have a tumor in a CSF-obstructing location (OR=6.0, $p=0.02$) than those who did not require a shunt. Preoperative CSF drainage in patients with hydrocephalus was not associated with need for permanent shunt. Extent of surgical resection ($p<0.001$), low tumor grade ($p=0.01$), and tumor location ($p=0.008$) were associated with progression-free survival (PFS). Extent of resection was a strong independent determinant of favorable PFS ($p=0.002$).

Conclusions: Younger patients who present acutely with intracranial ependymoma in proximity to CSF-obstructing regions are more likely to require permanent CSF diversion. Our findings also confirm the critical importance of complete surgical resection for survival of these children.

122. Cervicothoracic non-terminal Myelocystocele with Mature Teratoma: Case report and review of literature

Loyola Veronique Gressot, MD; Carrie Mohila, MD, PhD; Andrew Jea, MD; Thomas Luerssen, MD; Robert Bollo, MD (Houston, TX)

Introduction: Non-terminal myelocystocele is a rare type of spinal dysraphism characterized by a closed defect with an underlying CSF cyst, either contiguous with central spinal canal or attached to the spinal cord by a fibroneurovascular stalk. We report the case of a neonate with cervicothoracic non-terminal myelocystocele found to contain a mature teratoma.

Methods: Case report.

Results: A prenatal ultrasound at 25 weeks revealed a neural tube defect. Fetal MRI showed a neural tube defect with a splayed spinal cord extending into a

skin-covered cyst. At birth there was 4 x 5 cm posterior midline bulge at the cervicothoracic junction covered by dysplastic skin but without cerebrospinal fluid leak. Post-natal brain and spine MRI revealed a Chiari II malformation and demonstrated that the central spinal canal was continuous with the cystic neural tube defect, consistent with a Rossi type 2 non-terminal myelocystocele. The patient underwent repair of the defect on day of life #5. The dysplastic neuroglial wall of the cystic lesion was identified protruding from incompetent dura and was resected from the dorsal spinal cord. The open central canal of the spinal cord was visible after resection, confirming a type 2 non-terminal myelocystocele. Histopathologic analysis of the lesion demonstrated neuroglial tissue with ependymal lining associated with a mature teratoma. The patient is doing well at three month follow-up

Conclusions: To our knowledge, this is the first reported of a non-terminal myelocystocele containing a mature teratoma. We recommend surgical excision of the myelocystocele with the tumor lesion.

123. Chiari Malformation Type I: Preliminary Data from a Cognitive Intervention Study

David M. Frim, MD, PhD, FAANS, FACS; Kaitlin Dunn, BA; Maureen Lacy, PhD; W. Fong (Chicago, IL)

Introduction: In our prior work, visual learning and memory problems were documented in children with Chiari Malformation Type I. In the current study we examined the impact of brief cognitive training on performance.

Methods: Children diagnosed with Chiari Malformation Type I completed a battery of neuropsychological tests at baseline and again after completion of a 5 week intervention program (e.g., computer based or one on one therapy). Patients: Age Mean 9.6= (sd=3.1); Grade Mean = 3.25 (sd=2.9) & Male Gender =6. Statistical Analysis: Paired T Test were conducted using SPSS-20.

Results: Baseline data revealed mild learning problems [RCF Immediate T score = 35.4 (sd=8.8), Delayed Free T score = 35 (sd=7.4); Recognition T score = 47.7 (sd=8.8)] which improved post intervention [RCT Initial T score 44.8 (7.5); t= -3.3; p= .01: Delayed Free T score = 43.8 (sd=8.0); t=-3.9; p. = .004; Recognition T = 45.1 (sd=12.1); t=.62; p = .55]. Notably, there was no significant improvement in the Copy Trial (p=.16).

Conclusions: While practice effects can not be ruled out, this preliminary data suggests potential acute benefit from cognitive focused interventions.

124. Withdrawn

125. Clinical outcome of pediatric patients with a tethered spinal cord secondary to fatty filum terminale

Jeffrey Pugh, MD; Matthew Herman (Edmonton, Canada)

Introduction: Appropriate treatment of an asymptomatic tethered cord is controversial particularly when secondary to a fatty filum. At our institute, the management of these patients has evolved and we have at times offered prophylactic surgical release, and more presently follow patients and make surgical decisions based on clinical factors. As such, we are well positioned to discuss the clinical outcomes of patients treated along each of these competing pathways.

Methods: Retrospective review from 1995-2013 of 84 pediatric patients with fatty filum as the cause of a tethered cord. Patients were divided based on clinical presentation and treatment offered: conservative management, prophylactic release, and surgical release of patients presenting symptomatically. The majority of patient data was gathered from surgical records, therefore there is an exaggerated percentage of surgical cases.

Results: Of eight conservatively managed patients with MRI confirmed fatty filum, four remained asymptomatic while four developed symptoms requiring surgical release. All four patients showed resolution of symptoms. Of nineteen prophylactic releases, one required a secondary release due to retethering. Five patients suffered transient symptoms postoperatively and one patient had a surgical wound complication for a complication rate of 37% (7/19). Of fifty-seven patients surgically managed because of symptoms at presentation, symptom resolution was variable. Orthopedic symptoms (23) improved in fourteen cases (61%). Urological symptoms (40) improved in twenty-five cases (63%). Weakness symptoms (23) improved in fifteen cases (65%). Pain symptoms (20) improved in fifteen cases (75%).

Conclusions: The natural history of a tethered cord from a fatty filum is not benign given that 57 patients presented symptomatically, plus an additional 4 patients deteriorated during clinical observation. Additionally, patients presenting with tethered cord syndrome have incomplete resolution of their symptoms in more than 1/3 of cases. However, it is important to recognize that many patients with tethered cord syndrome have comorbidities, and persisting disabilities may be related to their underlying syndrome. Our retrospective data set under-identifies patients followed expectantly. Importantly, all patients who demonstrated clinical symptoms during observation had complete resolution of those symptoms with release of their tethered cord.

126. Withdrawn

127. Withdrawn

128. Corpus Callosotomy, Benefits and Risks in Pediatric vs Adult patients: A systematic review of the evidence

Walter John Hader, MD, FAANS; Yarema Bezchlibnyk, MD, PhD; Samuel Wiebe, MD, MSC (Calgary, Canada)

Introduction: Corpus callosotomy is an accepted method of reducing the frequency and severity of seizures including drop attacks. The optimal extent of callosal section and age at surgery remain debatable. This study reviews corpus callosotomy with respect to seizure outcome and complications and extent of callosal section in pediatric vs adult patients.

Methods: We conducted a comprehensive literature search using multiple databases with a manual search of bibliographies of reviews and original articles. Full length articles including at least 10 patients with one year follow up were included. Articles of pediatric (<18) vs adult (<18) studies were included if age at surgery was clear.

Results: 19 articles described a total of 451 patients (234 adult and 217 pediatric). Based on intention to treat, 405 patients underwent partial callostomies (aCC) while 80 had either a staged or single complete callosotomy (tCC) resulting in a total of 485 procedures. For adult patients, in the aCC and staged plus tCC groups mean age at surgery was 28.2 and 32 yrs, while for pediatric patients the mean age at surgery was 11.3 and 11.4 respectively for aCC and tCC. When all seizures were considered jointly, 59.5 % (53.1-65.6%) of adult patients and 55.3% (48.7-61.8%) of pediatric patients experienced a favourable response to CC (p=0.390). When extent of section and seizure frequency were compared between age groups, 53.2 %(46.3-59.9%) of adults and 42.4% (35.3-49.9%) of children showed a favourable response to aCC(p=0.039). For staged and tCC, the values were 56.7% and 64.3 % respectively (p=0.625). No difference in permanent neurological deficits after aCC between adult (1.3%) vs pediatric (2.8%) or after staged or tCC (6.7% vs 8.0%) was seen.

Conclusions: Corpus callosotomy is an effective treatment to reduce seizure frequency in both pediatric and adult patients. The risk of permanent neurological deficits was similar between the age groups. Adult patients achieve a greater benefit to partial callosotomy compared to pediatric patients in this review

129. Correlation between head circumference measurement and ventricle size in premature infants with IVH

Joshua J. Chern, MD PhD; Brandon Miller, MD; William Boydoston, MD (Atlanta, GA)

Introduction: ntraventricular hemorrhage (IVH) associated with prematurity is a common etiology of hydrocephalus. The decision to perform CSF diversion procedures is based on radiographic and physical exam findings, but the correlation between the two is poorly documented.

Methods: All cranial ultrasound reports at our institution from 2008 to 2011 were queried for IVH. The authors reviewed cranial ultrasounds, head circumference measurements, operative interventions and significant clinical events.

Results: Of the patients receiving CSF diversion, 83% presented with a grade III or IV hemorrhage. 63% of patients with grade III or IV hemorrhage received CSF diversion. As expected, mean head circumference of patients with grade I or II IVH was larger than that of patients with grade III or IV IVH, and patients who received a VAD had larger Evan's ratios. In infants older than 30 weeks of gestation, there is a positive correlation between head circumference and Evan's ratio measurement. However, in younger infants and those with grade III and IV IVH, correlation between the two measurements was poor.

Conclusions: Head circumference is not a reliable predictor of HCP grade or ventricular size, especially in infants younger than 30 weeks of gestation. Therefore obtaining scheduled cranial ultrasounds is justified.

130. Cost Analysis of Endoscopic-Assisted Suturectomy with Postoperative Helmet Molding and Open Cranial Vault Repair of Sagittal Synostosis

Edward Ahn, MD; Abby Larson; Amir Dorafshar, MD (Baltimore, MD)

Introduction: Endoscope assisted strip craniectomy (EAS) with postoperative helmet molding has established evidence for less associated morbidity than cranial vault remodeling (CVR) in the treatment of sagittal synostosis. Previous studies have demonstrated reduced cost of EAS versus CVR in the first year of life. We aimed to compare inpatient and outpatient costs of the two procedures at a single institution.

Methods: Five years of inpatient billed cost data were compared retrospectively for patients having EAS or CVR to treat sagittal synostosis at Johns Hopkins Hospital. Cost data included total charges, room and board, OR charges, radiology, labs/transfusion, drug, supplies, and other associated charges. Inflation was adjusted using the consumer price index data for 2004-2013. Other factors compared were age at surgery, length of stay, and operating room time.

Results: 32 patients receiving EAS and 27 patients receiving CVR were identified. Mean total inpatient charges (including helmet charges) were $13,245 for EAS (range $8,779-$33,694) and $20,533 for CVR (range $10,529-$58,064). CVR patients accrued higher charges for anesthesia, OR, room and board, radiology, labs, and supplies. Age at surgery, OR time, and average length of stay were less for EAS than CVR. Drugs and therapy costs did not differ between groups.

Conclusions: EAS is less costly than CVR in an inpatient surgical setting. In addition to decreased morbidity, EAS is shown to be a cost effective option in the setting of an early diagnosis and treatment of sagittal synostosis.

131. Cost-effectiveness of a short-term pediatric neurosurgical brigade to Guatemala

Matthew C. Davis, MD; Khoi Than, MD; Karin Muraszko, MD; Hugh Garton, MD, MS (Birmingham, AL)

Introduction: With subspecialty surgical care often unavailable to poor patients in developing countries, short-term brigades have filled a portion of the gap. Here, we prospectively assessed cost-effectiveness of a pediatric neurosurgical brigade to Guatemala City, Guatemala.

Methods: Data were collected on a week-long annual pediatric neurosurgical brigade to Guatemala from the University of Michigan in October 2012. Disability Adjusted Life Years (DALYs) averted were the metric of surgical effectiveness. Cost data included brigade expenses, as well as all costs incurred by the local healthcare system and patient families.

Results: During the mission, 17 pediatric neurosurgical interventions were performed. Conditions suffered by these patients would result in 382 total DALYs. Using conservative values of surgical effectiveness, procedures performed averted 138.1 DALYs. Although all operative and post-operative costs were covered by the visiting surgical team, patients spent an average of $226 USD for pre-operative workup, travel, food/lodging, and lost wages (range: $36-$538). The local healthcare system absorbed a total cost of $12,910. Complete mission costs were $53,152, for a cost-effectiveness of $385 per DALY averted.

Conclusions: To our knowledge, this is the first study evaluating cost-effectiveness of a short-term neurosurgical brigade. While surgical intervention is acknowledged as playing a crucial role in global health, subspecialty surgical care is still perceived as a luxury. Although providing care through local surgeons is likely more efficient than bringing in foreign medical teams, such care is not universally available. This study argues that volunteer neurosurgical teams can provide high-complexity care with a competitive cost-effectiveness profile.

132. Cyanoacrylate Dressing Reduces External Ventricular Drain Infection Rates

Markus Bookland; Markus Bookland, MD; Vishad Sukul, MD; Patrick Connolly, MD (Sandy Springs, GA)

Introduction: A cerebrospinal fluid (CSF) infection related to external ventricular drain (EVD) placement is a significant source of morbidity among neurosurgical intensive care patients. Current rates of EVD-related infections range from 2-45% in the literature. Skin-base flora account for the bulk of these infections. The authors posit that a liquid polymer dressing, 2-octylcyanoacrylate, provides a superior barrier to these bacteria than conventional semi-occlusive dressings, reducing EVD-related ventriculitis.

Methods: Ventriculitis rates were gathered retrospectively from 259 patients whose EVD sites were dressed with sterile semi-occlusive dressings that underwent routine sterile exchanges every 48 hours, per institutional protocol. 113 patients whose EVD sites were dressed once at insertion with 2-octylcyanoacrylate surgical adhesive (Dermabond, Ethicon Inc, Somerville, NJ) were similarly reviewed for their retrospective rate of ventriculitis.

Results: Patients with standard bio-occlusive dressings and sterile wound care had a 15.1% rate of positive CSF cultures, while patients with a 2-octylcyanoacrylate dressing had a 3.54% rate (p=.002). Staphylococcus accounted for 79.5% of ventriculitises among the bio-occlusive dressing patients. 25.0% of ventriculitises among the liquid polymer sealant dressing patients were Staphylococcus. This represents a 90% reduction in Staph. infections (p=.04) and correlates with the observed overall reduction in CSF infections.

Conclusions: The single application of a sterile liquid polymer dressing to EVD wounds and exit sites provides superior prophylaxis against EVD-related ventriculitis than conventional sterile dressing care. The culture results from this limited study suggest that the effect is driven by the blockage of retrograde migration of Gram-positive skin flora along the EVD exit site.

133. Deep Brain Stimulation in Children and Young Adults with Secondary Dystonia

Eisha Christian, MD; Joffre Olaya, MD; Diana Ferman; Quyen Luc, MD; Frank Attenello, MD; Mark Krieger, MD; Terry Sanger, MD, PhD; Mark Liker, MD (Los Angeles, CA)

Introduction: Deep brain stimulation, specifically of the globus pallidus interna, has been shown to be extremely effective in primary generalized dystonia. There is much less evidence for the use of DBS in patients with secondary dystonia. We present a series of 9 patients with secondary dystonia who underwent pallidal DBS at our institution.

Methods: A retrospective review of 9 patients with secondary dystonia who received treatment with DBS between February 2011 to February 2013 was

performed. Preoperative and postoperative videos were scored using the Barry Albright Dystonia (BAD) score and Burke-Fahn-Mardsen Dystonia Rating Scale (BFMDRS) by a neurologist specializing in movement disorders. In addition, the patient's families completed a subjective questionnaire to assess their perceived benefit of DBS using the following scale: -1 (worse), 0(no benefit), 1(minimal benefit), 2(good benefit), 3(excellent benefit).

Results: BAD scores improved by 9% (p=0.04) from 26.5 to 24. BFMDRS scores also improved by 9.3% with a p-value of 0.055. Of note, even in patients with minimal functional improvement, there seemed to be decreased contractures and spasms leading to improved comfort levels. In the subjective questionnaires, three patient's families reported good benefit, four reported minimal benefit, and one reported no benefit. Average follow-up to postoperative evaluation was 3.8 months. In addition, we had no complications such as infections or hematoma in our series.

Conclusions: Deep brain stimulation does provide benefit to a segment of the secondary dystonia population. Our results demonstrate that subjective gains reported by family questionnaire are notable in 7 of 9 patients. Objective improvements in BADS and BFMDRS are clearly demonstrated in certain generalized secondary dystonia patients but not in others. Larger follow up studies of DBS for secondary dystonia focusing on age, history, etiology, and patterns of dystonia, are needed to learn which patients will respond to DBS.

134. Deep brain stimulation for treatment of secondary dystonia acquired by drug overdose and anoxic brain injury: A case study

Eisha Christian, MD; Joffre Olaya, MD; Diana Ferman; Quyen Luc, MD; Frank Attenello, MD; Mark Krieger, MD; Terry Sanger, MD, PhD; Mark Liker, MD (Los Angeles, CA)

Introduction: Dystonia can be classified as primary or secondary with primary dystonia being associated with genetic mutations and secondary being due to environmental factors. Deep brain stimulation, specifically of the globus pallidus interna(GPi), has been shown to be effective in primary dystonia. There is much less evidence for the use of DBS in patients with secondary dystonia. This case report is a unique presentation of a patient who developed secondary dystonia after a drug overdose with significant improvement after pallidal DBS.

Case Study: DM is a 20 year old male referred for severe dystonia that developed after a hypoxic event from an accidental drug overdose. On initial exam, he had generalized dystonia of the face, neck, trunk, and extremities. He was unable to walk even with assistance and had limited control of his upper extremities. T2 weighted MR sequences showed bilateral involvement of the pallidum and lateral thalamus. A thin cut CT was obtained with the fiducial box in place and the images were combined with previously obtained T1 and T2 MRI images to assist in the targeting of the posteroventral globus pallidus interna bilaterally. Medtronic model 3387 permanent quadripolar electrodes were implanted.

Results: DM was assessed using both the Burke-Fahn-Marsden Dystonia rating (BFMDRS) and the Barry-Albright Dystonia (BAD) scale. His preoperative BFM score was 82 and BAD was 27. His postoperative BFM score was 57.5 (30% improvement) and BAD was 21 (22% improvement).

Conclusions: Larger follow up studies of DBS for secondary dystonia focusing on age, history, etiology, and patterns of dystonia, are needed to learn which patients will respond to DBS.

135. Differences in treatments and outcomes for patients with craniosynostosis treated in the United States: impact of socioeconomic variables and ethnicity.

Doniel Gabriel Drazin, MD; doniel drazin, MD; Faris Shweikeh; Miriam Nuno, PhD (Los Angeles, CA)

Introduction: Craniosynotosis is often treated with neurosurgical intervention. The aim of this study was to research, analyze, and present the clinical and socioeconomic characteristics of craniosynostosis patients, and to report current national trends.

Methods: Using Kids' Inpatient Database for the separate years of 2000, 2003, 2006, and 2009, craniosynostosis patients were identified using ICD-9 diagnosis codes and their associated procedure codes. Clinical features, demographics, inpatient procedures, outcomes, and charges were collected and analyzed.

Results: Of the 4,996 patients identified, 90% were treated at urban teaching hospitals, 62% were white, 24% were Hispanic, and 66.8% were male. Whites tended to have private insurance (68.2%) compared to non-whites (55.7%) ($p < 0.001$). Nearly 65% of the patients were from southern or western regions. When admitted, 14% were urgent or emergent. Mean length of hospital stay (LOS) was 3.5 days with no differences among races. Following surgical treatment, 4.9% of patients developed complications, most commonly hemorrhage or hematoma (3.3%), pneumonia (0.93%), and stroke (0.31%). Mortality was 0.07% without significant difference among the races. Mean overall hospital charges were significantly lower for whites than non-whites ($36,347 versus $46,116 [Hispanics] and $48,358 [African Americans], $p < 0.0001$).

Conclusions: Our findings indicate that Hispanics and males have a higher risk of developing craniosynotosis. Hispanics comprise around 16% of our population, yet 24% of craniosynostosis patients were Hispanic. More craniosynostosis patients were found in the west and south. Lack of early detection resulted in a significant percentage of urgent or emergent admissions. Though mean LOS and mortality did not differ among different races, non-whites had, on average, $10,000-$12,000 more charges. As our government and the healthcare system struggle to control medical costs, our analysis provides relevant socioeconomic and ethnic statistics for consideration regarding this costly neurosurgical intervention. Most important, our study found that craniosynostosis surgery is relatively safe with low mortality and morbidity.

136. Disparities in Clinical and Economic Outcomes in children and adolescents with intracranial aneurysms in the United States

Doniel Gabriel Drazin, MD; Doniel Drazin; Faris Shweikeh, BA; Holly Dickinson, BA; Miriam Nuno, PhD (Los Angeles, CA)

Introduction: The literature regarding intracranial aneurysms primarily relates to adults, with few studies reporting pediatric aneurysms. Our aim was to access a national database, analyze, and report clinical characteristics, epidemiological aspects, treatments and outcomes in pediatric patients.

Methods: Using Kids' Inpatient Database for years 2000, 2003, 2006, and 2009, patients with primary diagnosis of subarachnoid hemorrhage that underwent a coil or clip primary procedure were identified by ICD-9 codes. Patients with coil and clip procedure were excluded. Our retrospective analysis looked at patient characteristics, operative and non-operative procedures, and outcomes.

Results: 632 patients (78.7% <11-18) with aneurysms were analyzed: 56.7% ruptured, 43.3% unruptured, 53.6% male, 51.7% white, 20.6% Hispanic, 16% black, 3.8% Asian/Pacific Islander. Incidence is increasing with 65% of cases reported in the two latest years. Patients with ruptured aneurysms were: 40.9% white, 26.4% Hispanic, 18.6% black, 4.6% Asian/Pacific Islander, 55.6% coiled, 44.4% clipped. About 62% of unruptured aneurysms were coiled. 93% were treated at teaching hospitals. 63% of discharges (90% for ruptured versus 31% of unruptured) were non-routine ($p<0.0001$). For ruptured versus non-ruptured: mean length of hospital stay was 15 versus 5.4 days (respectively, $p < 0.0001$), and 12.1 days for clipped versus 9.9 days for coiled ($p<0.0001$). Only 25 children expired (3.9%). Regarding total hospital costs, ruptured aneurysm costs were more than double ($165,546 versus $78,207, $p<0.0001$) with no significant difference between coiling and clipping costs.

Conclusions: We identified 632 aneurysms in four selected years indicating this condition is much more common. Coiling was utilized more often, paralleling treatment of adult aneurysms. Endovascular treatment was higher for unruptured

patients. Patients with ruptures had longer hospital stays, higher hospital costs, higher mortality and more non-routine discharges. The pediatric population had lower in-hospital mortality but more non-routine discharges, thus higher morbidity. Pediatric aneurysms are more common in adolescents than previously thought, and therefore need to be more routinely recognized and considered as a possible diagnosis.

137. Does aggressive management of hydrocephalus with shunts reduce the development of symptomatic Chiari II malformation in newborns?-results from a 10 year experience

Brandon G. Rocque, MD; Ralee' Bishop; Betsy Hopson; W Oakes, MD; R Tubbs, PhD; Jeffrey Blount, MD (Birmingham, AL)

Introduction: Medullary dysfunction from Chiari II malformation (C2M) remains the leading cause of death for newborns with myelomeningocele. Treatment remains controversial. Two approaches have been advocated: (1) assertive control of hydrocephalus and (2)surgical decompression of the rostral cervical spinal canal. Our institutional embrace of the first approach has prompted an aggressive surgical approach to the management of hydrocephalus which was evaluated over a decade of clinical experience.

Methods: A retrospective study of all newborns with myelomeningocele evaluated and treated at our center between 2000 and 2010 was performed. Comprehensive data was tabulated, and data addressing hydrocephalus management, cervical decompression and symptomatic medullary dysfunction was analyzed

Results: 118 patients infants with myelomeningocele (14 thoracolumbar, 35 lumbar, 58 lumbosacral, 11 other) were treated. Most defects were closed on day of life 1 (mean 1.72+- 2.16). Indications for shunt placement were based on MOMS criteria, the majority of which were for documented increase in ventricular size or head circumference (57%) or wound leak (9.3%). Utilizing these criteria 101 patients (85.6%) had CSF shunt placed within 90 days of birth, and 108 (91.5%) had shunt placed during the follow up period. There was no correlation between CSF leak and time to defect closure, nor size or level of lesion. Twenty-two patients underwent 1 shunt revision; 7 patients had 2 revisions; and 3 patients had 3 revisions. Indications for shunt revision were similar to initial shunt placement. None of the parameters collected were associated with increased rate of shunting. Five patients (4.2%) developed signs of medullary dysfunction in infancy for which they were each treated with C2M decompression (C2MD). An additional 5 patients underwent C2MD during the follow up period for other reasons (syrinx, unremitting neck pain). Three patients required tracheostomy or gastrostomy support. There was one mortality.

Conclusions: In our experience, aggressive shunting of infants with myelomeningocele was associated with low rates of medullary dysfunction. Gains in lower rates of medullary dysfunction are substantially tempered by morbidity associated with higher shunt rates.

138. Dorsal Spinal Cord Stimulation for Recurrent Tethered Cord Syndrome

Rachana Tyagi, MD FAANS; Shruti Shah, MD (New Brunswick, NJ)

Introduction: Recurrent tethering after surgery for lipomyelomeningocele is common and often leads to multiple surgical detethering procedures with progressively worsening outcomes. Various approaches to the problem have been attempted, including analgesics, physical therapy, repeat untethering, and in extreme cases, spine-shortening procedures. Our patient already had complete functional incontinence of both bowel and bladder that did not improve after her last detethering procedure, therefore the risks of a repeat untethering were felt to outweigh the benefits given the likely poor success of the surgery. We present an alternative treatment with dorsal spinal cord stimulation for a patient with recurrent symptoms of progressive pain and paresthesias in the back and lower extremities.

Methods: A percutaneous SCS stimulator was placed with leads at T8-9, with significant pain relief lasting the entire duration of the 3 day trial. A St. Jude permanent implanted stimulator was subsequently placed with the paddle at the same level.

Results: She reported improvement in her VAS pain scale from 8/10 to 2/10 and 70% pain relief with the percutaneous leads, and a further decrease to 1/10 at 6 months after placement of the permanent stimulator with 80% pain relief. She also noted significant improvement in her ADL and psychological function. She was able to ambulate without a cane and requested a note for return to work. She had no change in her bowel and bladder function.

Conclusions: Dorsal spinal cord stimulation is an alternative for treatment of recurrent tethered cord syndrome secondary to lipomyelomeningocele with excellent relief of pain at 6 months, with no new/worsening neurologic deficit.

139. Withdrawn

140. Endoscope-Assisted Microsurgery for Complex Brainstem Lesions

Yasser Jeelani, MD; Scellig Stone, MD, PhD; Ossama Al-Mefty, MD; Alan Cohen, MD (Boston, MA)

Introduction: The surgical resection of complex tumors located adjacent to the brainstem can be challenging and may sometimes require unconventional approaches. This report describes the use of endoscope-assisted microsurgery in the management of such lesions at our institution. The merits and risks of this operative strategy are discussed and two case examples are presented.

Methods: We report the use of endoscope-assisted microsurgery to facilitate the removal of complex tumors adjacent to the brainstem and present two case examples demonstrating the efficacy of this technique.

Results: Case 1. A 30-month-old girl presented with progressive neurological deterioration characterized by headache, irritability, vomiting, dysarthria, ophthalmoplegia, facial diplegia, weakness and ataxia. MRI showed a large non-enhancing retroclival tumor with diffusion restriction that markedly deformed the brainstem at the pontomedullary junction. The tumor was resected with a posterior fossa microsurgical approach working through the thinned fourth ventricular floor using neurophysiological monitoring. A rigid endoscope inserted through the fourth ventricular floor permitted visualization of anatomy not seen by the microscope. Pathology was epidermoid and the patient had a dramatic postoperative improvement. Case 2. A 12-year-old boy complained of progressive headaches for a year and had a right abducens palsy and truncal ataxia. MRI showed a larged heterogeneously enhancing clival tumor with marked deformation of the brainstem. The tumor, a chordoma, was resected through an endoscope-assisted microsurgical subtemporal approach with an anterior petrosectomy. The endoscope permitted visualization of blind corners not seen by the microscope. The patient had a smooth postoperative course.

Conclusions: Endoscope-assisted microsurgery is a powerful technique for managing complex tumors adjacent to the brainstem. The endoscope allows the surgeon to see around blind corners and facilitates resection of difficult lesions. The technique is safe and adds little time to the operation.

141. Endoscopic treatment of isolated fourth ventricular cyst as a sequelae of post-hemorrhagic hydrocephalus in ex-premies

David A. Chesler, MD PhD; Edward Ahn, MD (Baltimore, MD)

Introduction: Trapping of the fourth ventricle is most often encountered in the setting of post-hemorrhagic hydrocephalus of premature infants and can be associated with brainstem compression. Treatment traditionally involves shunting or fenestration of the fourth ventricle through a posterior fossa approach, and more recently a supratentorial transcortical approach. Here we describe our modification and early experience of this technique using a combined stereotactic and endoscopic method to fenestrate and shunt the trapped fourth ventricle via the lateral ventricle through the expanded choroidal fissure.

Methods: BrainLab navigation was used to direct a rigid endoscope into the lateral ventricle through a trans-frontal approach. A trajectory through an expanded choroidal fissure was identified in all cases providing access to the trapped fourth ventricle which was fenestrated. A trans-frontal fourth ventricular catheter was placed under direct visualization and connected to peritoneal shunt in standard fashion.

Results: Five patients underwent this procedure with an average of 32.6 months of follow-up. Mean age at time of surgery was 35.4 months with an average of 5.2 prior operations. Mean time to shunt failure was 752 days with proximal malfunction (40%) being the most common cause. No neurologic complications were identified in the immediate post-operative period.

Conclusions: These early results suggest endoscopic transfrontal, transventricular fenestration and shunting of a trapped fourth ventricle in pediatric patients with post-hemorrhagic hydrocephalus presents a safe and viable treatment option. Further this approach may provide greater longevity of shunt patency compared with infratentorial approaches and minimize the risk to eloquent structures compared with previously described supratentorial approaches.

142. Endovascular Treatment of Stroke with the Solitaire Stent-Triever in Two Pediatric Patients

John Lawrence Gillick, MD; Dhruve Jeevan, MD; Yin Hu, MD; Michael Stiefel, MD, PhD (Valhalla, NY)

Introduction: Pediatric ischemic stroke is a rarely encountered clinical entity with an estimated incidence of 1.3-13 per 100 000. Furthermore, very little literature exists regarding its treatment. We present two cases of pediatric ischemic stroke in which endovascular therapy was employed.

Methods: A retrospective review of two pediatric patients at our institution that suffered ischemic stroke was performed. These patients had undergone endovascular stroke therapy with intra-arterial thrombolysis. These patients National Institute of Health Stroke Scales (NIHSS) were observed at discharge and 3 months.

Results: A 7 year-old boy with an NIHSS of 17 and a 9 year-old girl with an NIHSS of 16 both underwent endovascular treatment for stroke. In the first case, the patient underwent right middle cerebral artery (MCA) and right internal carotid terminus mechanical thrombectomy using the Solitare FR stent-triever (eV3, Irvine, California). The patient was discharged with an NIHSS of 8. At 3 months, his NIHSS was 2. In the second case, the patient underwent mechanical thrombolysis of the left MCA and anterior cerebral artery (ACA) with the Solitare FR stent-treiver and Penumbra 3 max catheter (Penumbra, Alameda, California). She was discharged with an NIHSS of 8. At 3 months, her NIHSS was 6.

Conclusions: Pediatric stroke can present a challenge in treatment. in addition, there are very few cases reported of endovascular therapy in pediatric stroke. These cases show that current endovascular therapies may be employed in the pediatric setting.

143. Endovascular and surgical management of dural sinus malformations

Catherine Ann Miller, MD; Daniel Guillaume, MD; Bharathi Jagadeesan, MD; Andrew Grande, MD; Ramachandra Tummala, MD(Minneapolis, MN)

Introduction: Dural sinus malformations are rare pediatric vascular lesions. Two types are recognized: midline involving the posterior sinus with giant dural lakes and slow flow arteriovenous (AV) shunting, and lateral involving the jugular bulb with high flow sigmoid sinus AV shunting.

Methods: We describe the clinical presentation and management of two unique DSMs. Both differed from previously reported midline DSMs in that neither involved low flow AV shunts. The first patient presented with cardiac failure, intracranial hemorrhage, and seizures. She had a large midline DSM with multiple high-flow dural and pial AV shunts. In the second patient, a large midline DSM was identified prenatally. On postnatal imaging, the lesion had no AV connections. Both patients were successfully treated with a combination of techniques including percutaneous transfontanelle and endovascular embolization, posterior fossa decompression, cranial expansion, and CSF diversion.

Results: Patient 1 was meeting developmental milestones at her 24 month follow up with imaging showing marked decrease in the thrombosed midline venous pouch, no new AV shunts, and a patent superior sagittal sinus. At 12 month follow-up, Patient 2 was meeting most developmental milestones, with some motor delay. Imaging revealed significant reduction in the size of the DSM and decreased ventriculomegaly with subsequent brain expansion.

Conclusion: Early diagnosis and treatment of DSMs is critical to prevent cardiac failure or parenchymal injury from chronic venous hypertension. A combination of percutaneous transfontanelle embolization, endovascular embolization, and adjuvant neurosurgical decompression and CSF diversion is shown in our cases to treat these lesions with good outcomes.

144. Evidence-based Recommendations for the Treatment of Children with Hydrocephalus

Ann Marie Flannery, MD, FAANS, FACS; Catherine Mazzola, MD; Paul Klimo, MD, PhD; David Limbrick, MD, PhD; Lissa Baird, MD; Tina Duhaime; Joanna Kemp, MD; Mandeep Tamber, MD, PhD; Dimitios Nikas, MD; Mark Van Poppel, MD; Laura Mitchell; Jay Rivas-Cambrin; Kurt Auguste, MD, PhD (Saint 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. The review resulted in a total of 19 recommendations in the 9 areas including 6 recommendations with sufficient strength to be Class I

Conclusions: There is evidence of sufficient strength to make strong recommendations in some key areas of hydrocephalus management. The areas where there is insufficient or weak evidence are potential targets for future studies

145. External Validation of the Chicago Chiari Outcome Scale

Chester Kossman Yarbrough, MD; Jacob Greenberg, BA; Matthew Smyth, MD; Jeff Leonard, MD; Tae Sung Park, MD; David Limbrick, MD, PhD (Saint Louis, MO)

Introduction: Historically, assessment of clinical outcomes following surgical management of Chiari malformation type 1 (CM-1) has been challenging due

to the lack of a validated instrument for widespread use. The Chicago Chiari Outcome Scale (CCOS) is a novel system intended to provide objective evaluation of outcomes for patients with CM-1. The goal of this study was to evaluate the performance of the CCOS using an external study population.

Methods: Patients undergoing surgery for CM-1 from 2008 to 2010 were reviewed (n=118). Outcomes were evaluated using the CCOS, along with a gestalt impression of whether patients experienced a significant improvement after surgery. The gestalt and CCOS evaluations were independently scored by two individuals, and interrater reliability was assessed using the intraclass correlation coefficient (ICC) and kappa (κ) statistic.

Results: The median CCOS was 15, and 66% of patients had improved gestalt scores after surgery. Overall, the CCOS was effective at identifying patients with improved outcome after surgery. The interrater reliability of the CCOS (ICC=0.71) was high, though the reliability of the component scores ranged from poor to good (ICC 0.23 to 0.89). When analyzing gestalt outcome, there was moderate agreement between raters (=0.58).

Conclusions: In this external validation study, the CCOS was effective at identifying patients with improved outcomes and proved more reliable than our gestalt impression of outcome. However, certain component scores (functionality and non-pain symptoms) were found to be less reliable, and could potentially be better defined. Overall, we found the CCOS to be an improvement over the previously utilized assessment of outcome at our institution.

146. Facial hamartoma resection in a patient with CHARGE syndrome: Review of experience.

Shaun D. Rodgers, MD; David Friedmann, MD; Irene Kim, MD; Maja Svrakic, MD; Irina Mikolaenko, MD; J. Roland; Jeffrey Wisoff, MD (New York, NY)

Introduction: CHARGE (Coloboma of the eye, Heart defects, Atresia of the choanae, Retardation of growth and/or development, Genital and/or urinary abnormalities, and Ear abnormalities and/or deafness) syndrome is a genetic disorder. CHARGE can be a cause of deaf/blind children. Inner ear malformations may be prominent in CHARGE patients. Facial nerve hamartomas may present in this population.

Methods: Our group presents the case of a 14 month old female with a variant of CHARGE syndrome including colobomatas with good functional vision, ASD, VSD, absent semicircular canals, hypotonia, but does not have choanal atresia with moderate functional hearing and normal waves on intraoperative ABR. She presented with a facial palsy shortly after birth caused by a facial hamartoma. The patient underwent resection of the facial hamartoma and sural nerve grafting for facial reanimation.

Results: Pathologic examination demonstrated a glioneuronal hamartoma with portions of compact GFAP-positive paucicellular glial tissue with rare Neu-N immunoreactive small neuronal cells. Electron microscopy revealed tissue composed of compact glial processes.

Conclusions: Facial Hamartoma may be an additional feature seen in some CHARGE patients. The management decision for facial palsy due to facial hamartoma can be complex. The pathology presented uniquely demonstrates a facial hamartoma in a variant of CHARGE syndrome. Further follow-up will be needed to determine the clinical efficacy of facial reanimation for this patient.

147. Factors Influencing Delayed Diagnosis of Low Grade Gliomas In Pediatric Patients

Aska Arnautovic, BS; Ibrahim Qaddoumi, MD, MS; David Daniels, MD, PhD; Frederick Boop, MD; Paul Klimo, MD, MPH; Amar Gajjar, MD (Washington, DC)

Introduction: Delay in diagnosis (DID) has been a recognized problem in children with brain tumors. Factors influencing this have not been well studied. The goal of this review was to determine whether symptom duration is impacted by race, age, tumor grade, or tumor location in children with low grade gliomas (LGGs) and whether DID impacts extent of resection (EOR), progression, or survival.

Methods: A single-institution retrospective review of 258 children with histologically confirmed LGG treated from 1995-2005 was conducted.

Results: There were 131 males; 201 Caucasians, 42 African Americans, and 15 other. The median number of symptoms per patient was 2 and the majority of patients had symptoms for less than 3 months (57%). There was no evidence of association between DID and race (p=.85) nor tumor location (p = 0.58); however, there was an association between DID and tumor grade (p=0.019). There was also evidence that age (<6 years) was associated with longer duration of symptoms. There was no statistical evidence of an association between EOR, survival, or disease progression and DID.

Conclusions: A DID did not negatively impact EOR, progression, or overall survival. A DID was associated with age, but not race or tumor location. Efforts to increase awareness of the diverse range of presenting symptoms in pediatric patients with LGG, particularly older children (<6 years), should be made by health care providers to expedite diagnosis and treatment.

148. Factors associated with repeated Emergency Department visits by pediatric neurosurgery patients

Joshua J. Chern, MD PhD; Markus Bookland, MD; Andrew Reisner, MD; Barunashish Brahma; David Wrubel; William Boydston, MD (Atlanta, GA)

Introduction: Pediatric neurosurgical patients who visited Emergency Department (ED) may return to ED within 30 days of discharge from ED or after inpatient stay.

Methods: Patient characteristics were prospectively collected in the hospital database. Patients with repeated ED visits within a 30 day period were identified.

Results: 3,459 consults and admissions by neurosurgical service occurred in the ED in a 3-year period. Average age was 7.17 +/- 6.04 years. The word shunt and its variations appeared in the chief complaint in 848 visits (24.5%). Patient presented with blunt trauma to the head, resulting in non-displaced skull fracture and concussion in 1,185 visits (34.2%). There were 2,081 admissions (60.1%), and 1,778 of which were followed by neurosurgical procedures, which included 1,040 shunt-related procedures. The primary end point of interest is related return to ED within 30 days of discharge (patients who returns to ED within 30 days of discharge from ED or from inpatient stay and who presented with complaints that were related to neurosurgical diseases). There were 262 such related returns to the ED. In the multivariate logistic regression analysis, patients who presented with shunt complaint or underwent shunt surgery following admission were more likely to return to ED (p<0.001, OR 1.844 and p<0.001, OR 1.584, respectively). In the subgroup analysis of blunt head trauma (n=1,139), 465 of these visits resulted in admissions. Following discharge, 17 of these patients returned to ED within 30 days with related complaints. In contrast, in the group that was not admitted (n=674), 21 patients returned to ED within 30 days. Patients who presented with blunt head trauma were statistically unlikely to return to ED (p<0.001, OR 0.458) compared to others.

Conclusions: Pediatric neurosurgery patients with a CSF shunt carry a significant propensity for return to ED within 30 days of an ED visit. In contrast, our data show that uncomplicated blunt head trauma patients may be safely discharged from the ER.

149. Finding the optimal Condylar-C1 Interval (CCI) distance in predicting Atlanto-Occipital Dislocation: An assessment of two different approaches at a Pediatric Level One Trauma Center

Walavan Sivakumar, MD; Colin Kazina, MD; Douglas Brockmeyer, MD (Salt Lake City, UT)

E-POSTER ABSTRACTS

Introduction: Atlanto-occipital dislocation (AOD) is a common problem in the pediatric trauma population. In order to detect AOD we have used condylar-C1 interval (CCI) measurements from initial trauma CT scans. However, since published norms for CCI vary widely (from 1.28mm to 2.5mm) there is difficulty determining the best cut-off point for the upper limit of normal, resulting in excessive imaging for unaffected patients. This study examines the result of using two different CCI cut-off points in determining AOD, with radiographic confirmation of AOD as the endpoint.

Methods: In a retrospective review of our institutional trauma registry from 2004 to 2012, 36 patients were identified as having concern for AOD. Using previously published methodology, we determined the CCI for each patient using their initial CT scan. Patients with CCI's greater than 4mm were excluded from further analysis. The remaining patients were analyzed with two different methodologies, using a CCI upper limit of normal of 2.0mm in Group A and 2.5mm for Group B. The number of CCI-generated false positive diagnoses was calculated.

Results: Nine patients were excluded from analysis due to death or lack of initial CT imaging. Six patients had CCI's < 4mm and did not undergo further imaging. Of the remaining 21 patients, Group A had a CCI false positive rate of 60% and Group B a rate of 33%.

Conclusions: When using CCI methodology in diagnosing AOD, using 2.5mm as the upper limit of normal decreases the number of false positives significantly.

150. Giant cell reparative granuloma of the pediatric cranium: case report and review of the literature

Adam Michael Conley, MD; Gary Tye, MD; Jennifer Rhodes, MD (Richmond, VA)

Purpose: Giant cell reparative granulomas are rare bone tumors. Although benign, these tumors are locally destructive and can be highly vascular. They seldom occur in the cranial vault. We describe a multidisciplinary approach to a case of giant cell reparative granuloma of the cranium in a 3-year-old patient.

Case Report: A 3-year-old female referred to the pediatric neurosurgery department for evaluation of a retroauricular mass. She had a history of recurrent otitis media with two subsequent courses of antibiotics without resolution. CT imaging revealed an expansive lesion located in the right mastoid region. Open surgical biopsy revealed a hemorrhagic tumor consistent with a giant cell reparative granuloma. Angiography identified a hypervascular tumor blush that was supplied by the occipital artery. Preoperative transcatheter embolization was performed followed by a multidisciplinary surgical resection and reconstruction. Blood loss was minimal, and the patient recovered well after surgery.

Conclusion: Preoperative endovascular embolization and a multidisciplinary intraoperative approach with primary resection and cranial vault reconstruction is an effective approach to hypervascular giant cell reparative granulomas.

151. Glucose Levels are Predictive of Prolonged Seizure Activity

Chevis Shannon, MBA, MPH, DrPH; Kelly Pekala, MS; Katherine Kelly; James Leathers; Reagan Caldwell; Amber Greeno, RN; John Wellons, MD, MPH; Noel Tullipam, MD (Nashville, TN)

Introduction: In previous studies, hyperglycemia has been correlated with poor neurologic outcomes in the pediatric population and increased overall morbidity and mortality. The objective of this study was to analyze the implications of serum glucose levels at time at admission on prolonged seizure activity, requiring medication at discharge.

Methods: A retrospective study of 1800 children undergoing treatment and management of Traumatic Brain Injury (TBI) between January 2006 and April 2013 at Vanderbilt University Children's Hospital was conducted. Serum glucose levels were stratified into 4 ranges: (0-69, 70-140, 141-199, 200+ mg/dl). Patient age was subdivided into very young (0-4), children (4-15) and adolescents (15-18). Descriptive statistics, multivariate and logistic regression were conducted using SAS 9.3

Results: Patients below the age of 4, caucasians and males represented the majority of our cohort. We found that 18% of patients with prolonged seizure activity had hypoglycemia (p=0.001). Regression models showed that serum glucose levels (p=0.0064), age (p=0.0324), responsiveness at presentation (p<0.001), interaction terms glucose and responsiveness (p=0.001), and glucose and age (p=0.0055) were statistically significant predictors of prolonged seizure activity. Regression models demonstrated that GCS score of 9-15 (p<0.001), age 0-4 (p<0.001), blunt injury (p=0.0403), and hypoglycemia (p=0.0013) were significantly associated with hospital disposition to home.

Conclusions: We found that serum glucose levels on admission, age, responsiveness at presentation, interaction terms glucose and presentation and glucose and age were statistically significant predictors of seizure outcome in the pediatric TBI population.

152. Head injuries following TV related accidents in the pediatric population

David John Daniels, MD PhD; Adam Befeler, MD; Susan Helms; Paul Klimo, MD; Frederick Boop, MD (Germantown, TN)

Introduction: Current data indicates the rate of TV related injuries caused by falling TVs is increasing. There is limited data on the injury patterns associated with these accidents. Our goal was to confirm and characterize the high rate of head injuries in these patients and determine the economic burden caused by these accidents.

Methods: A single-institution retrospective review of all children treated for a TV related injury at a level I trauma center between 2009 and 2013 were identified through our trauma registry. Type, mechanism and severity of CNS related injuries, surgical intervention, outcome and costs were documented.

Results: Twenty-six patients were treated for a TV related injury during this time. Most injuries occurred in children ages 2 to 4 (85%, mean age 3.3) with the majority (73%) being male. Head injury occurred in 20 patients (77.0%) and ranged from concussion, skull fractures, subdural, subarachnoid and intra-parenchymal hemorrhages. GCS was abnormal in 13 cases (range 7 - 15). Neurological deficits were identified in 3 patients and surgical intervention was required in 5 cases. The majority of patients made a full recovery. Total cost for TV related injuries was $1.4 million dollars with an average $52,200 per accident. There were no deaths.

Conclusions: A high occurrence of head injuries was seen following TV related accidents in young children. The Pediatric Section and AAP should develop a public education campaign targeting parents, health care workers and TV manufacturers to prevent these injuries and unnecessary medical costs.

153. Hospital care of shaken baby syndrome in the United States: a neurosurgical perspective

Doniel Gabriel Drazin, MD; Doniel Drazin, MD, MS; Faris Shweikeh, BA; Holly Dickinson, BA; Miriam Nuno, PhD (Los Angeles, CA)

Introduction: Shaken baby syndrome (SBS) is a serious condition for which the neurosurgeon can provide important management and interventions. In this study, our aim was to analyze cases of children diagnosed with SBS and to report the clinical and epidemiological characteristics, medical treatments provided, and patient outcomes.

Methods: Using ICD-9 codes, we accessed the Kids' Inpatient Database (KID) for the separate years of 2000, 2003, 2006, and 2009 to identify patients with a primary diagnosis of SBS. We conducted a retrospective analysis of this nationally representative sample, looking at patient characteristics, inpatient operative and non-operative procedures, and outcomes.

Results: 1,804 patients were admitted for SBS, varying by year. The overwhelming majority were younger than one year of age (88%) and were

male (61.3%). More than 80% of patients were admitted emergently, urgently, or as a trauma. Presenting signs included retinal hemorrhages (71%), subdural hematoma (59.2%), cerebral edema (13.9%) and anoxic brain injury (12.1%). Treatments performed were as follows: intensive care management with mechanical ventilation (47.5%), transfusion of blood products (22.7%), arterial pressure monitoring (13.3%), parenteral or enteral nutrition infusion (8.8%), electroencephalogram monitoring (8.1%), intracranial pressure monitoring (5.8%). Ventricular shunting was provided in 10.4% of the cases. Additional neurosurgical interventions included anterior fontanel puncture for aspiration (11.1%), drainage of intracranial collections (10.6%), craniotomy and/or craniectomy (2.7%), and other intracranial procedures (7.4 %). Mean length of hospital stay was 12.1 days. Overall mortality was 15.4%.

Conclusions: Although the two most recent years analyzed showed a decreasing incidence, SBS unfortunately remains a significant problem for children and the healthcare system. Many patients present in critical condition and others require immediate attention. Classic signs of SBS are not seen in all patients. Neurosurgical management can provide essential and lifesaving interventions to decrease mortality and morbidity.

154. Hydrocephalus in the Setting of Plasminogen Deficiency: Follow Up of a Case at Ten Years

rakan farouk bokhari; Bassam Addas, MBBS; Bassim Albeirouti, MBBS (jeddah, Saudi Arabia)

Introduction: Plasminogen deficiency (PD) is a rare disorder that disrupts fibrin degradation. A rare association is hydrocephalus (HCP), with less than 20 cases identified, and only five detailing the course of HCP. We describe our experience with such a case followed up for 10 years making it the longest surviving case in the literature.

Methods: We report a case being followed for the past ten years with several interesting developments. In addition, the medical literature was reviewed for all hydrocephalus cases associated with PD.

Results: Our patient was diagnosed in the neonatal period with obstructive HCP compatible with aqueductal stenosis. We performed an endoscopic third ventriculostomy that failed within a few days, leading to a ventriculoperitoneal shunt. Extra-CNS manifestations later led to the diagnosis of plasminogen deficiency. The subsequent ten years witnessed multiple proximal and distal catheter revision that led to a ventriculoatrial(VA) shunt, a contralateral VA shunt, insertion of a fourth ventricular catheter and finally a ventriculocholecystic shunt that was just recently revised 4 months after installation. We also saw her HCP transform into a communicating pattern, then back to an obstructive pattern. Plasminogen replacement was by frozen plasma transfusion every other day indefinitely that maintained systemic remission and most likely contributed to our case's initial remarkably prolonged VA shunt survival for a period of five years.

Conclusions: Our case represents a very rare variant of hydrocephalus that requires a multidisciplinary approach. It documents new insights into PD-associated HCP and provides evidence suggesting a role for continuous systemic therapy.

155. Iliac Screw Placement in Neuromuscular Scoliosis Using Anatomic Landmarks and Uniplanar AP Fluoroscopic Imaging

Loyola Veronique Gressot, MD; Akash Patel, MD; Steven Hwang, MD; Daniel Fulkerson, MD; Andrew Jea, MD (Houston, TX)

Introduction: Neuromuscular scoliosis is a challenging pathology to treat. Surgical correction can entail long fusion to the pelvis. The deformity inherent to these patients makes obtaining lateral intraoperative x-rays for traditional image guided placement of iliac screws difficult.

Methods: An assessment of 14 patients with neuromuscular spinal deformity, 12 of which (mean age 14.25 years; range 10-20) underwent long (mean 15 levels; range 10-18) fusion to the pelvis and 2 who underwent placement of growing rods with iliac screw placement. Iliac screws were placed after identifying the posterior superior iliac spine (PSIS) and using only AP fluoroscopy (view of the inlet of the pelvis), rather than the technique of direct palpation of the sciatic notch. The accuracy of iliac screw placement was assessed with postoperative CT.

Results: Twelve patients had 24 screws placed as part of a fusion to the pelvis, and 2 patients had 2 iliac screws placed as part of a growing rod construct for neuromuscular scoliosis. There were no iliac screw misplacements or complications directly related to the technique of iliac screw placement. Average follow-up was 35.8 months (range 6-64).

Conclusions: A less invasive technique for iliac screw placement can be performed safely with a low likelihood of screw misplacement. This technique offers the biomechanical advantages of iliac fixation without the soft tissue exposure typically needed for safe screw insertion. The technique relies on identification of the PSIS and quality AP fluoroscopic imaging for a view of the pelvic inlet.

156. Impact of age and operation on adverse events in craniosynostosis patients

Michael DeLong; Kyle Halvorson, MD; John Gallis, MS; Carrie Muh, MD, MS; Jeff Marcus, MD; Shivanand Lad, MD, PhD (Chapel Hill, NC)

Introduction: Surgical intervention for craniosynostosis varies widely with regards to type of repair and age at first operation. Postoperative adverse events and eventual reoperation rates secondary to this variability have not been completely defined.

Methods: All non-syndromic craniosynostosis patients who underwent surgical repair and had a recorded birth date were selected by CPT/ICD 9 codes from the Thompson Reuters Marketscan Database. Logistic regression models were used to compare 90-day adverse event rates according to age at surgery and procedure used. Relative reoperation events were assessed using Cox proportional hazards modeling. Fisher exact testing was used to determine impact of gender.

Results: Of 1232 patients, 644 (52.3%) underwent surgical repair between 0 and 6 months, 471 (38.2%) between 6 and 12 months, and 117 (9.5%) between 1-3 years. Strip craniectomy alone was performed in 515 (44.3%) cases, and cranial vault reconstruction (CVR) was performed in 647 (52.5%). Surgical intervention between 6 and 12 months of age was associated with increased incidence of postoperative hemorrhagic events and transfusions compared to earlier repair (hemorrhagic 6.2% vs 3.0%, transfusion 26.3% vs 21.3%, both $p < 0.05$). Additionally, hemorrhagic events were more frequently observed in male patients (5.0% vs 2.3%, $p = 0.03$). Lastly, repair with CVR was associated with an increased reoperation rate compared to repair with strip craniectomy (8.7% vs 2.9%, $p < 0.001$).

Conclusions: Repair between 6 and 12 months and male gender may increase the risk of adverse bleeding events in craniosynostosis patients. Additionally, CVR surgery may increase eventual reoperation rate compared to strip craniectomy.

157. Implications of radiological changes in the Frontal Lobe following Frontofacual Surgery - are we underestimating our morbidity

Owase Jeelani; Alistair Cobb; Peter Boavida; David Dunaway; Rosanne Docherty; Dawn Saunders; Richard Hayward (London, United Kingdom)

Introduction: The frontofacial monobloc advancement with oste- ogenic distraction is increasingly used as a surgical treatment for children with complex craniosynostosis-associated syndromes. How- ever, the subfrontal osteotomy cuts to free the facial skeleton from the skull base require extradural retraction of the frontal lobes. The purpose of this study was to determine the frequency and degree of radiologically identifiable frontal lobe changes and whether any such changes affected the patients' outcome.

Methods: The clinical records and preoperative and postoperative computed tomography imaging of all patients undergoing mono- bloc frontofacial distraction advancement (with or without bipar- tition) were reviewed. A retrospective medical notes review was undertaken to assess any patient or surgically related factors that might predispose to frontal lobe changes and evaluate outcome from surgery. Where available, magnetic resonance imaging scans were reviewed to compare outcome with that on computed tomography

Results: Fiftycaseswereidentifiedassuitableforthestudy.Eighteen patients (36%) had no frontal lobe changes. Thirty-two cases (64%) did have changes that appeared related to the position of maximum retraction during subfrontal osteotomy cuts. There were no changes in the incidence/extent of these changes over time or of any link to the patients' diagnosis, age at surgery, phenotype severity, surgery type, or any surgical or postoperative adverse events. We found no evidence that these changes were responsible for neurologic pro- blems (eg, epilepsy) or reduced cognitive function.

Conclusions: This study reveals a high incidence of frontal lobe changes demonstrable on neuroimaging following the frontofacial monobloc procedure reflecting the retraction points during surgery. Although no postoperative disability was reported, it is clearly im- portant to consider more detailed neuropsychologic testing and re- view current surgical techniques to ensure that such changes are kept to a minimum

158. Incidence of Delayed Intracranial Hypertension in Children with Non-syndromic Sagittal Synostosis Following Open Calvarial Vault Reconstruction

Clarence Gill; Peter Ray, MD; John Grant, MD; Jeff Blount, MD; Curt Rozzelle, MD; James Johnston, MD (Madison, AL)

Introduction: Delayed intracranial hypertension (DIH) is well described in children with syndromic multi-suture synostosis. Other large craniofacial centers have reported their data on the incidence of DIH in non-syndromic sagittal synostosis patients undergoing open repair. This study reports the frequency of reoperation for delayed intracranial hypertension in children following open sagittal synostosis repair at our center, and aims to provide additional primary data to the discussion of this topic.

Methods: A single center retrospective study of patients who had undergone open calvarial vault remodeling for sagittal synostosis at the University of Alabama Cleft and Craniofacial Center at Childrens of Alabama between November 2000 and April 2013 was performed. Data were extracted from clinic and hospital records for analysis.

Results: 106 consecutive patients with isolated sagittal synostosis were included for analysis. Average clinical follow-up was 3.9 years (range: 1 month - 11.3 years), with an average age at initial operation of 12.0 months. Three (2.8%) of 107 patients presented with clinical symptoms of delayed intracranial hypertension, all confirmed with ICP monitoring, and underwent cranial vault expansion at an average age of 55.8 months. Contrary to other reports, sex and age at initial operation were not associated with increased risk of delayed intracranial hypertension.

Conclusions: Consistent with previous reports, we observed a low rate of reoperation for delayed intracranial hypertension in children with nonsyndromic sagittal synostosis following open calvarial vault reconstruction. No specific patient risk factors were identified.

159. Infected Lumbar Dermoid Cyst Mimicking Intramedullary Spinal Cord Tumor: Report of 2 Cases and Review of the Literature

Sudhakar Vadivelu, DO; Sohum Desai, MD; Anna Illner, MD; Tom Luerssen, MD; Andrew Jea, MD (Houston, TX)

Introduction: We report two unusual cases of a 17-month-old boy with a previously undiagnosed lumbar dermal sinus tract terminating in an intradural dermoid cyst and holocord edema or syrinx, presenting with paraparesis and sphincter dysfunction secondary to an intramedullary abscess; and a 26-month-old boy with a previously undiagnosed lumbar dermal sinus tract terminating in an infected dermoid cyst and intramedullary abscess, presenting with recurrent episodes of meningitis and hydrocephalus.

Methods: We retrospectively reviewed our two cases and performed a literature review to determine the cumulative experience of management of intramedullary abscess in this rare clinical setting.

Results: Preoperative MR imaging studies in these patients were initially confused for an intramedullary spinal cord tumor; however, the presence of an associated dermal sinus tract made this diagnosis of neoplasm less likely. Total excision of the dermal sinus tract, debulking of the dermoid cyst, and drainage of the intramedullary abscess through an L1-L5 osteoplastic laminoplasty and midline myelotomy, followed by long-term antibiotic therapy resulted in a good functional recovery. Postoperative MRI of the spine showed removal of the dermoid cyst, decreased inflammatory granulation tissue, and resolution of the holocord edema or syrinx.

Conclusions: We presented two unusual cases of children with intramedullary abscess and holocord edema secondary to an infected lumbar dermoid cyst presenting with paraparesis and regression of developmental milestones. The constellation of radiographic findings mimicked that of an intramedullary spinal cord tumor with syrinx. The pathomechanism for the holocord edema or syrinx is not clearly elucidated. Like most authors, we recommend prompt surgical treatment including the resection of the dermal sinus tract and dermoid cyst, and drainage of the intramedullary abscess.

160. Influence of Age on the Angioarchitecture of Brain Arteriovenous Malformations

Nalin Gupta, MD, PhD, FAANS; Daniel Cooke, MD; Jeffrey Nelson; Heather Fullerton, MD; Matthew Amans, MD, MS; Jared Narvid, MD; Parham Moftakhar, MD; Christopher Dowd, MD; Randall Higashida, MD; Van Halbach, MD; Michael Lawton, MD; Helen Kim, PhD; Steven Hetts, MD (San Francisco, CA)

Introduction: The goal of this this study was to define how the clinical and angioarchitectural features of brain AVMs differ between children and adults with brain AVMs.

Methods: A prospectively collected institutional database of all patients seen with brain AVMs (children=203; adults=630) since 2001 was queried. Demographic and angioarchitecture information was summarized and analyzed with univariable and multivariable models. Age was analyzed as both a continuous and dichotomous variable.

Results: Children were more likely to present with AVM hemorrhage than adults (59% vs. 41%, $p<0.001$). Although AVMs with a larger nidus presented at younger ages (mean of 26.8 years for <6 cm compared to 37.1 years for <3 cm), this was not significantly different between children and adults ($p=0.069$). Exclusively deep venous drainage was more common in younger subjects both when age was treated as a continuous ($p=0.04$), or dichotomous ($p<0.001$) variable. Venous ectasia was more common with increasing age (mean, 39.4 years with ectasia compared to 31.1 years without ectasia) and when adults were compared to children (52% vs. 35%, $p<0.001$). Patients with feeding artery aneurysms presented at later average age (44.1 years) than those without such aneurysms (31.6 years); this observation persisted when comparing children to adults (13% vs. 29%, $p<0.001$).

Conclusions: Although children with brain AVMs were more likely to come to clinical attention due to hemorrhage than adults, venous ectasia and feeding artery aneurysms were underrepresented in children, suggesting that these particular high risk features take time to develop.

161. Withdrawn

162. Initiating and Developing a Multi-institutional and Multidisciplinary Pediatric Spasticity Program: A Potential Quality Improvement Model

Paul B. Hofrichter; Hector James, MD; Louise Spierre, MD; Philipp Aldana`, MD (Jacksonville, FL)

Introduction: This reports the initiation, development, structuring, and quality improvement aspects of the Pediatric Spasticity Program at Wolfson Children's Hospital (WCH)/University of Florida College of Medicine Jacksonville (UFCOMJ).

Methods: This is a multi-institutional collaborative effort involving the UFCOMJ, Nemours Children's Clinic, and WCH. Phase I: Recruitment of a pediatric physical medicine and rehabilitation (PPMR) physician and nurse practitioner (ARNP). As part of training, team members visited and participated in the activities of the Spasticity Program at Primary Children's Medical Center in 2010. Phase II: Educational information was provided by PPMR to the WCH operating room and floor nursing personnel, pediatric critical care medicine and the pediatric emergency department.

Results: The Spasticity Clinic initiated in December 2009 and patient team evaluations were performed by PPMR and pediatric physical therapy (PT). Recommendations are made for the treatment of spasticity: PT, OT, intramuscular Botox injections, baclofen trials, and others. Baclofen trials are performed by PPMR and PT/OT. Monthly patient management conferences include participants from PPMR, pediatric neurosurgery, pediatric orthopedics, and PT/OT during which clinical findings are summarized with video presentations of the baclofen trials, and team management decisions follow. A total of 474 patients were seen in the Spasticity Clinic from 01/2010 to 12/2011. The first baclofen pump was inserted in 02/2010 and first rhizotomy performed in 08/2010. A total of 37 baclofen pumps were inserted and 6 selective dorsal rhizotomies performed from 02/2010-12/2011.

Conclusions: In the absence of a spasticity program, pediatric neurosurgeons can take the lead to initiate a similar venue for youth with spasticity.

163. Internal carotid artery bypass to external carotid artery bypass in an 18 month old infant; a case report, discussion of a single institution's experience in non-vein of Galen pediatric aneurysms and review of literature.

Catherine McClung-Smith, MD; Saleem Abdulrauf, MD; Samer Elbabaa, MD; Jeroen Coppens, MD; Randal Edgell, MD; Ann Flannery, MD (Saint Louis, MO)

Introduction: Non-vein of Galen intracerebral aneurysms are a rare entity in the pediatric population.

Methods: The authors present 4 cases of primary intracerebral aneurysm diagnosed in children under the age of 24 months from March 2010 through March 2013. The presentation, location, treatment strategies and follow up of the aneurysms are discussed.

Results: In two cases a good outcome was obtained with the infant being discharged with a good functional status. The first infant presented with new onset seizure activity resulting in an MRI and diagnosis of a complex left MCA bifurcation aneurysm. This infant underwent elective external carotid to internal carotid bypass of the MCA bifurcation aneurysm utilizing a saphenous vein graft with subsequent discharge home at baseline functional level 8 days postoperatively. The second infant was diagnosed secondary to a parietal hemorrhage and the aneurysm was treated endovascularly. This infant's outcome was directly related to the location of the hemorrhage and prompt treatment of the ruptured aneurysm; the infant has managed a good recovery. Of the 2 infants with poor outcomes, one infant was discharged devastated after rupture of a fusiform right A2 aneurysm and the second infant was discharged deceased, secondary to rupture of a partially thrombosed basilar tip aneurysm.

Conclusions: While cerebral aneurysms in the infant population are exceedingly rare, they remain a treatable disease with potential for good outcomes depending primarily on the presentation of the patient. Based on our institution's experience, even complex aneurysm requiring bypass are potentially curable.

164. Intracranial Dog Bite Injuries in Children

Amir Kershenovich, MD; Talora Steen, BS; Karen Ravin, MD; Shelly Timmons, MD (Danville, PA)

Introduction: Children are especially at risk for intracranial injuries from dog bites due to their small stature and thin skull bones carrying possible serious complications such as hematomas and infections. There are only 21 case reports in the literature. The aim of our study was to review our Institutional experience and compare it to a meta-analysis of the published english literature.

Methods: Cases were identified through the trauma database at Geisinger Health System between 1992 and 2010, and a retrospective chart review analysis was conducted and compared to the reported cases in the literature.

Results: We identified 10 patients with intracranial injuries secondary to dog bites that were treated in our Institution over 19 years. We found that the patients were usually treated with debridement, irrigation, and broad-spectrum antibiotics. None of the patients had infectious complications. Three experienced extra axial hematomas of which none required surgical evacuation. A meta-analysis of the literature was done and we found 21 cases published that in general reported more severe injuries and complications than our cohort, including dural lacerations, meningitis and abscesses.

Conclusions: Intracranial injuries from dog bites in children should be thoroughly investigated and aggressively managed by surgical debridement and irrigation in cases of scalp laceration. Surgical exploration should be undertaken when there is evidence of comminuted fractures on imaging studies. Additionally, a broad spectrum antibiotic should be initiated early (within 24 hs of the injury) and utilized for a relatively short period of time. Head CT without contrast is recommended for all children sustaining dog bites to the head. Follow up in the neurosurgery clinic can help in identifying early sub-acute or chronic infectious complications.

165. Withdrawn

166. Intraoperative Neurophysiology in Tethered Cord Surgery: Techniques and Results

Francesco Sala, MD; Vincenzo Tramontano, BS; Giovanna Squintani, MD; Chiara Arcaro, BS; Franco Faccioli, MD; Carlo Mazza, MD; Giampietro Pinna, MD (Verona, Italy)

Introduction: Intraoperative neurophysiologic monitoring (IOM) is nowadays extensively used to minimize neurological morbidity in tethered cord surgery. Our goal is to summarize our clinical experience using a multimodal IOM approach.

Methods: Between 2002 and 2012, we performed 48 surgical procedures in 47 patients with a tethered cord secondary to a variety of spinal dysraphisms, the majority being lipomas of the conus. Neurophysiological mapping of the cauda equina was performed through direct stimulation of these rootlets and bilateral recording from segmental target muscles in the lower limbs, and the anal sphincters. Monitoring techniques included somatosensory evoked potentials (SEPs), transcranial motor evoked potentials (MEPs) from limb muscles and anal sphincters, and the bulbocavernosus reflex (BCR).

Results: The monitorability rate was 84% for SEPs, 97% for limb muscle MEPs, 74% for the anal sphincter MEPs, and 59% for the BCR. SEPs, MEPs and BCR remained stable during surgery in all patients but one. This child showed worsening of a lower limb paresis and urinary/fecal incontinence, which completely recovered over 8 and 5 weeks respectively. In six patients an unexpected muscle response was evoked by stimulating tissue macroscopically considered as not functional.

Conclusions: Mapping techniques allow to identify and spare functional neural tissue and, vice-versa, to cut non-functional structures that may contribute to cord tethering. Monitoring techniques, MEPs and BCR in particular, improve the reliability of intraoperative neurophysiology, though these may require a higher degree of neuromonitoring expertise. IOM minimizes neurological morbidity in tethered cord surgery.

167. Intraoperative electrocorticography in pediatric refractory epilepsy patients predicts epileptogenic zone and resection areas

Regina Sheree Bower; Mark Bower, PhD; Jan Cimbalnik, MS; Ben Brinkmann, PhD; Dan Crepeau, BS; Matthew Stead, MD, PhD; W. Marsh, MD; Gregory Worrell, MD, PhD; Nicholas Wetjen, MD (Rochester, MN)

Introduction: Surgery for medically refractory epilepsy in children can be curative if the epileptogenic zone can be identified and resected. Intracranial EEG (iEEG) monitoring is the gold standard for determination of the epileptogenic zone. However, this method requires stereotypical clinical seizures, necessitating long-term monitoring, and carries risk, morbidity and cost. We hypothesized that intraoperative electrocorticography can yield adequate data to determine the epileptogenic zone.

Methods: After IRB approval, broadband (32 kHz), intraoperative iEEG data were collected from standard, clinical electrodes. Data collected during subsequent chronic monitoring identified epileptogenic and resection zones. Intraoperative recordings were analyzed offline for interictal spikes (peak <3 std.dev., spikewidth <50 msec) and High Frequency Oscillations (HFOs, line length <3 std.dev.). Detection counts were compared against epileptogenic and resection zones (ANOVA).

Results: Intraoperative and chronic iEEG data were collected on three pediatric patients with medically refractory epilepsy. Intraoperative data were analyzed for number of spikes on each electrode during a quiet recording period (<10 min). In all three patients, spike counts detected on intraoperative data were significantly correlated with electrodes representing both epileptogenic zone ($p<0.0001$, $p=0.0011$, $p=0.0459$), and resection area ($p<0.0001$, $p=0.0024$, $p=0.0459$). In one patient, HFO numbers also correlated with electrodes in both categories ($p<0.0001$). All patients had Engel class 1A outcome (mean follow-up 8 months).

Conclusions: This study demonstrates the correlation of intraoperative interictal spikes to the epileptogenic and resection zone, and that HFOs can provide additional localizing information. These results suggest that wide bandwidth intraoperative electrocorticography may be sufficient for the elimination of chronic iEEG monitoring.

168. Intraoperative ultrasound during surgery for intractable epilepsy in children

Alexander Gregory Weil, MD; Sanjiv Bhatia, MD; Alexander Weil, MD; Nolan Altman, MD; John Ragheb, MD; Luisa Cervantes, MD (Miami, FL)

Introduction: Complete excision of epileptogenic tissue represents one of the most important predictors of seizure freedom in patients undergoing surgery for intractable epilepsy. During surgery, recognition of the location and extent of the epileptogenic zone or lesion can be challenging. Adjuncts such as intraoperative electrocorticography and neuronavigation are commonly used to help map the epileptogenic zone and outline the boundaries of specific lesions associated with epilepsy. Intraoperative ultrasound (iUS) imaging can provide information regarding the location and extent of lesions. We report our observations using iUS to map out epileptic pathology and guide both resection, disconnective surgery and depth electrodes placement.

Methods: Preoperative and postoperative imaging studies, surgical, pathology reports, and hospital records were reviewed retrospectively for 22 procedures where iUS was performed during surgery for intractable epilepsy in patients.

Results: Twenty-two patients (age 3 months - 17 years) underwent electrode placement, resective surgery or hemispherectomy. Final diagnosis included cortical dysplasia in 8 cases, cortical tubers in 6, tumors in 5 and other lesions in 3. Intraoperative US provided valuable information on lesion localization, extent of resection, and electrode placement. It also helped in guiding entry to the lateral ventricle during hemispherectomies. There were no iUS-related complications. Postoperatively, all patients had MRI-documented successful lesion resection or electrode placement

Conclusions: Intraoperative US is a safe, inexpensive, and feasible adjunct in the surgical treatment of intractable epilepsy. It is particularly useful for distinguishing between normal parenchyma and cortical dysplasia, for obtaining precise resection, guiding the placement of depth electrodes and can facilitate hemispherectomy.

169. Is there a 'July Effect' Affecting Shunt Survival? Revisiting this Issue Using Prospectively Collected Data from the HCRN's Shunt Registry.

Jay K. Riva-Cambrin, MD, FAANS; John Kestle, MD; Sam Browd; William Whitehead; Richard Holubkov; James Drake; David Limbrick; Mandeep Tamber; Cutis Rozelle; Tamara Simon; John Wellons III; Abhaya Kulkarni (Salt Lake City, UT)

Introduction: The 'July Effect' is the notion that hospital services see a spike in complications in July and August, presumably from annual turnover of new housestaff. Previous reports were contradictory and this issue has important ramifications for patient care, resident training, and clinical performance metrics.

Methods: The HCRN Shunt Registry was examined for first shunt placements in children aged less than 19 years at 6 of the 7 HCRN sites. Shunt failure was defined as shunt revision or shunt infection. The independent variable at study was the calendar month in which the first shunt was placed. The Cox proportional hazard regression modeling included risk adjustment for age, etiology, cardiac co-morbidity, endoscope use, and shunt hardware.

Results: 1036 children underwent first shunt placement from April 2008 to December 2011. 344 patients had shunt failure including 265 malfunctions and 79 infections. Of shunts placed in July and August, 32.0% failed during follow-up versus 33.4% placed during all other months combined ($p=0.80$). Infections of shunts placed during July and August trended non-significantly lower (4.6%) versus 8.3% inserted the other months ($p=0.08$). In multivariable regression, shunts insertion in July or August was not associated with failure ($p=0.75$), whereas age, cardiac co-morbidity, and use of the endoscope remained significant, as previously reported by the HCRN.

Conclusions: We found no evidence to support a 'July Effect' in first shunt surgery using a large multi-centered cohort derived from the HCRN Shunt Registry with or without risk adjustment for known confounders.

170. Late Failure in Endoscopic Third Ventriculostomy

Heather Jane McCrea, MD, PhD; Matei Banu, MD, MS; Caitlin Hoffman, MD; Innocent Njoku, BA; Jeffrey Greenfield, MD, PhD; Mark Souweidane, MD (New York, NY)

Introduction: Endoscopic Third Ventriculostomy (ETV) is increasingly performed as an alternative to shunting. Late failures and sudden death have been anecdotally reported but without prevalence rates.

Methods: We reviewed our institution's early ETV cases (1997-2006) and identified cases with long-term follow-up (<1 year)to determine rate and predictive factors for late (<3 months) ETV failure. Failure was defined as need for shunt placement or repeat ETV, and time to failure was based on repeat procedure date.

Results: 66 patients had long-term follow-up (average follow-up 6.31 years). In

this cohort, six patients (9.1%) experienced failure after 3 months with average time to failure of 1.99 years (range .79-4.78 years). Two patients failed at 9-12 months, two at 1-2 years, and 3 at < 2 years. Additionally, one patient with no long-term follow-up failed at 9.4 months and one patient with successful ETV at our institution presented to us after failure of ETV done 10 years prior. At time of failure, patients primarily presented with signs and symptoms of raised ICP, but one was asymptomatic and underwent surgery due to lack of flow on MRI. There were no deaths in our series. Two patients had tectal gliomas, three had other tumors, and one had a quadrigeminal plate arachnoid cyst. No parameters achieved statistical significance for predicting late failure likely due to small sample size.

Conclusions: While most patients who fail ETV do so early, a significant number (9.1%) exhibit late failure. This underscores the need to continue follow-up and educate patients and family members on signs and symptoms of ETV failure.

171. Long-term outcome after surgery for brainstem tumors in children

Francesco Sala, MD; Daniele Nuzzi, MD; Miriam Mulino, MD; Barbara Masotto, MD; Albino Bricolo, MD; Carlo Mazza, MD (Verona, Italy)

Introduction: Except for diffuse gliomas, focal brainstem tumors are amenable to surgical treatment. Yet the long-term follow-up of surgical series is rarely reported. We reviewed long-term results in 51 children (mean age 10 years, range 1-17) operated on for brainstem tumors between 1994 and 2007.

Methods: Reviews of clinical charts and outpatient clinic reports as well as phone interviews were used to collect clinical, neuroradiological, and quality of life data. Based on the pre-operative MRI, tumors were classified as focal (n=20), exophytic (n=23), diffuse (n=6) or cervicomedullary (n=2). Tumor removal was classified as total (n=16), subtotal (n=32) or partial/biopsy (n=3). Pilocytic astrocytomas were the most common histological diagnosis (n=29). Radiotherapy (RT) and/or chemotherapy (CHT) were used in 16 patients.

Results: On February 2013, 7 patients are lost to follow-up, 13 are dead (all malignancies except 2), while 31 are alive at a mean follow-up of 137 months (range 64-219). Of these 31 patients, 8 have no evidence of disease, 21 have stable disease, 2 have small progression, and only two received adjuvant therapies following surgery. Eight patients are cognitively impaired and overall neurological impairment is absent/mild in 12, moderate in 7, while 5 are fully dependent on external support for daily activities. Currently, 9 patients are attending school, 12 are employed, 10 unemployed.

Conclusions: While the prognosis of diffuse and/or malignant brainstem tumors remains dismal, surgery alone warrants long-term survival in the majority of low grade tumors, especially pilocytic astrocytomas. Among survivors who became adults, about half are employed.

172. Lumbar Atrial Shunts in the Treatment of Hydrocephalus

Neena Ishwari Marupudi, MD; Brenna Mell; Steven Ham, DO; Sandeep Sood, MD (Detroit, MI)

Introduction: Patients with pseudotumor cerebri and hydrocephalus without ventriculomegaly are often treated with lumbar-peritoneal-shunts (LPS). Chronic shunt-treated hydrocephalus is also best treated with LPS due to propensity for acute deterioration with recurrent malfunction from slit-like or isolated ventricles. LPS patients who fail peritoneal shunting require an alternative shunting site.. We propose the use of lumbar-atrial-shunts (LAS) when LPS, despite revisions, fail due to lack of peritoneal absorption from chronic shunting. We present the first series of patients treated with LAS.

Methods: Fifty-three patients with history of slit ventricles or pseudotumor cerebri and failure of LP shunt were converted to LA shunts between 2000-2012 at our institution. The initial shunt was placed at a mean age of 26-months. Patients were converted to LAS from LPS by tunneling up to the level of the clavicle and passing an atrial catheter via a subclavian approach; we used a horizontal-vertical valve appropriate in vertical pressure to patient height. The rate of infection/malfunction was compared before and after conversion to a LAS.

Results: Median age at conversion to LAS was 11-years. Six patients eventually were no longer shunt dependent and had their shunt removed. Seven patients required connection of their LAS to a ventricular catheter due to development of an isolated ventricle and failure of endoscopic ventriculostomy. Mean follow-up period was 5-years. The malfunction rate per patient decreased from 4.2 shunt-revisions-per-year while a LPS to 2.6 ($p<0.04$) as a LAS. Infection rate was significantly improved (17% while LPS and 9.4% after conversion to LAS, $p < 0.03$). 30.2% (n=16) of patients were evaluated for headaches with an ICP monitor while a LAS was in place. ICP ranged from 2 to 8 cmH2O in these patients, confirming effective shunting.

Conclusions: Conversion to a LAS is a safe and effective procedure in patients and continues to maintain a reduced rate and severity of subsequent malfunctions. In patients with communicating hydrocephalus whose peritoneal cavity is unsuitable for shunting, conversion to a LAS may be indicated. The dynamics of LAS may prevent over-shunting symptoms.

173. Lumbar pedicle trajectory in patients with spinal dysraphism

Steven W. Hwang, MD; Rachel Engelberg, MD; Marie Roguski, MD; Ron Riesenburger; James Kryzanski, MD; Andrew Jea, MD; Daniel Do-Dai, MD (Boston, MA)

Introduction: In patients with open neural tube defects, there is a high incidence of scoliosis and often patients require fusions for deformity correction. Anecdotally, the lumbar pedicle trajectory is more medial than in the reported average population, but this has not been described in the literature to date.

Methods: We performed a single institution, retrospective review of pediatric patients with the diagnosis of an open neural tube defect. Functional and anatomical levels of the defects were noted. CT and MRI of the lumbar spine were analyzed, and vertebrae from L1-S1 were measured for pedicle width (W), length (L), and midline angle (α). Radiographic measurements were compared bilaterally, at each level, and with historical data for the normal population.

Results: 16 pediatric patients (mean = 3.0 ± 4.3 years; 7 male, 9 female) with a diagnosis of either myelomeningocele or lipomyelomeningocele were assessed. Most defects (75%) occurred in the lumbar region, with L2 and L5 accounting for 37.5% of each. No significant difference existed between right and left pedicle measurements (W: $0.65 \le p \le 0.94$; L: $0.91 \le p \le 1$; α: $0.24 \le p \le 0.86$); however, all angles demonstrated a quadratic increase from L1 to S1 (L1: mean = 28.3±5.2°; L2: mean = 29.1±6.2°; L3: mean = 33.2±6.0°; L4: mean = 36.8±5.6°; L5: 43.8±5.9°, L5: mean = 52.0±3.6°) and were more medially angulated than those in the reported in the normal population historically.

Conclusions: Lumbar pedicles in spinal dysraphic patients demonstrated a more medial angle trajectory when compared with values in the normal population.

174. MRI guided laser ablation in the treatment of pediatric intracranial tumors: SUNY Upstate Golisano's Children Hospital experience.

Zulma Sarah Tovar-Spinoza, MD; David Carter, MD; Amit Singla, MBBS; Sean Huckins, MS (Syracuse, NY)

Introduction: Laser-induced thermal therapy (LITT) is an emerging technology for the treatment of intracranial pathologies. LITT uses laser energy delivered through a fiberoptic catheter inserted into the lesion through a 3 mm cranial opening; the ablation is performed under MRI guidance. Its successful use in adult intracranial lesions has increasingly been reported. However, the literature on the use of LITT in pediatric intracranial lesions is limited.

Methods: We present our experience with the use of LITT in pediatric patients

with different intracranial tumors. Post-operative and short-medium term follow-up outcomes are presented.

Results: We treated 6 patients with intracranial tumors (Thalamic Pylocitic astrocytomas, Subependymal Giant Astrocytoma, Thalamic Ependymoma, gangliocytoma and bilateral Choroid Plexus Xantogranulomas) between February 2012 and August 2013. The age of the patients ranged from 4 to 17 years. No intra-operative complications were noted, 2 patients had post op transient weakness due to brain edema. Tumors reduction in size and resolution were followed on the 3,6, 12 months.

Conclusions: Laser-induced thermal therapy under MRI guidance appears both technically feasible and clinically safe to treat a variety of intracranial neoplasms. Post-operative and short-term follow-up outcomes are promising. Larger series and long-term outcomes are needed to better define the indications and demonstrate the efficacy of this emerging technology.

175. Magnetic Resonance Imaging and Spectroscopic Characteristics of Glioblastoma Multiforme in a Pediatric Population

Frank Joseph Attenello III, MD; Eisha Christian, MD; Tong Yang, MD; Rupal Parikh, BS; Stephanie Da Silva, BA; Floyd Gilles, MD; Jonathan Finlay, MD; J. Gordon McComb, MD; Mark Krieger, MD (Los Angeles, CA)

Introduction: Glioblastoma Multiforme (GBM) remains a rare neoplasm in the pediatric population. As a result, GBM is often confused for benign astrocytomas or primitive neuroectodermal tumor. Few studies have attempted to define a specific radiologic profile for this pediatric disease process. We attempt to characterize pediatric GBM via magnetic resonance imaging (MRI) and spectroscopy for pediatric GBM on presentation.

Methods: We evaluated all children with biopsy proven GBM and available preoperative MRI or MR spectroscopy treated at our institution from 2000 to 2013. Preoperative MRI was evaluated for volume of contrast-enhancing mass, tumor location, and characteristic ring enhancement surrounding necrotic center. MR spectroscopy was described by characteristic elevated and decreased molecule composition.

Results: 15 patients (12+5 years) were identified with available preoperative MRI. Lesions measured 27+22 cubic centimeters and most commonly occurred in the frontal region (33%), followed by parietal-occipital (20%), temporal (20%), thalamic (13%) and cerebellum (13%). Classic ring enhancement surrounding a definitive hypointense center only occurred in 20% of lesions. 10 patients (13+4 years were identified with preoperative MR spectroscopy. Lesions uniformly showed elevated choline to creatine ratios with elevated lipids and lactate in 70%.

Conclusions: GBM displays a consistent MR spectroscopic profile in the pediatric population and does not often present as the classic ring enhancing mass found in the adult population.

176. Management of Children with Mild Traumatic Brain Injury and Intracranial Hemorrhage

Jacob K Greenberg; Ivan Stoev, MD; TS Park, MD; Matthew Smyth, MD; Jeffrey Leonard, MD; Jose Pineda, MD; David Limbrick, MD, PhD (St. Louis, MO)

Introduction: Traumatic brain injury (TBI) is a significant public health problem affecting tens of thousands of children each year, and an important subset of these patients sustains intracranial hemorrhage (ICH). This study aimed to describe rates of clinical complications in this population in order to determine the appropriate care pathway for patients with an initial plan for non-operative management (intensive care unit (ICU) versus ward observation).

Methods: We performed a retrospective review of patients ≤18 years of age with mild TBI (Glasgow Coma Scale score 14-15) and traumatic ICH admitted to Saint Louis Children's Hospital between 2006 and 2011 (n=121).

Results: Radiologic progression was noted in 5/47 (11%) patients who received repeat imaging, with a trend toward more frequent progression in patients with epidural hematoma (EDH) versus other ICH (3/11 (27%) vs. 2/36 (5.6%); p=0.08). Neurosurgical intervention was significantly more common in patients with EDH compared to those with other types of ICH (4/19 (21%) vs. 2/102 (2.0%); P<0.01). By contrast, there was no difference in the frequency of neurological decline between patients with EDH (2/19, 11%) and those with other types of ICH (3/102, 2.9%) (P=0.17). Despite overall low complication rates, most (70%) patients spent at least one night in the ICU.

Conclusions: These results suggest that rates of neurological deterioration and neurosurgical intervention in children with mild TBI and ICH are low, particularly in patients without EDH. We present management recommendations regarding which children with mild TBI and ICH may be safely observed on a general neurosurgery ward.

177. Management of Shunt Infections with Intrathecal Antibiotics

Alexandra Beier, DO; Philipp Aldana, MD; Paul Hofrichter, NP; Richard Postlewait; Hector James, MD (Jacksonville, FL)

Introduction: Although many protocols have been initiated to decrease the risk of cerebrospinal fluid shunt infections, they are still prevalent in the pediatric neurosurgical population. It is also known that the risk of re-infection is increased after shunt internalization following a shunt infection. The senior author has described his previous series of shunt infections treated with intrathecal antibiotics from 1975-2004 that found a zero percent re-infection rate. The authors provide additional data supporting the use of intrathecal antibiotics for the treatment of shunt infections.

Methods: A retrospective review was performed on patients diagnosed with a shunt infection from 2004-2013, as a follow up from the senior author's (HEJ) initial series from 1975-2004. Patients were classified as having a shunt infection when shunt reservoir aspirate revealed positive microbial growth. These patients underwent shunt removal with external ventricular drain placement with both intravenous and intrathecal antibiotics or had removal of shunt with ventricular taps for neonates. Patients were classified into simple or complex infections. Simple infections required an infection with one organism with a simple shunt system. Complex infections included multiple organisms, multiple compartment hydrocephalus, severe peritonitis, infections in other body sites, and/or fungal infection.

Results: Thirty-five patients with a cerebrospinal fluid shunt infection from 2004-2013 were identified for a total of 39 infections. Of these patients, 32 were treated with intrathecal antibiotics. One patient underwent shunt removal without replacement, otherwise all shunts were internalized after clearance of the infection. Four patients experienced shunt re-infection (12.5%), all being of the complex variety with only one patient being re-infected with the same organism (3.1%). Analyzing the senior author's previous data and the current study, 110 infections were treated with intrathecal antibiotics over a 38-year span, with a total re-infection rate of 3.6%. Furthermore, the re-infection rate of patients with an initial simple shunt infection was zero.

Conclusions: Intrathecal antibiotics provide a safe manner to treat cerebrospinal fluid shunt infections with a low re-infection rate.

178. Midline mandibular osteotomy and anterior fusion for a complex pediatric aneurysmal vertebral cyst

Michael McDowell; Simon Hanft, MD; Sophie Greenberg, BS; Richard Anderson, MD (New York, NY)

Introduction: We report the surgical management of an extensive lesion of the upper cervical spine that required an innovative transmandibular approach in order to facilitate exposure. A 6 year old patient with a large aneurysmal bone cyst of the C2 vertebrae presented with progressive weakness and right sided

neck pain for treatment. The lesion extended inferiorly to C4 and posteriorly around the spinal cord.

Methods: Neither transoral nor retropharyngeal approaches were felt to be suitable for treatment, and thus a transmandibular osteotomy was performed to allow for gross resection of the mass and a subsequent anterior C1-C3 fusion with a cage.

Results: The patient tolerated the operation well and had regained all function at follow up. No complications of swallowing or respiration occurred.

Conclusions: The transmandibular approach for the treatment of upper cervical spine lesions is an effective method of maximizing exposure for complex lesions and lesions in which maximal resection is called for such as aneurysmal vertebral cysts. When this operation is performed with care in order to avoid injury to the airway and neurovasculature, it can be safely applied to pediatric cases.

179. Minimally invasive treatment of non-syndromic, sagittal synostosis: A single institution experience

James Messegee, MD; Muhammad Chohan, MD; Barbara Bell, NP; Erich Marchand, MD (Albuquerque, NM)

Introduction: Early surgical correction of single suture sagittal synostosis is shown to improve both cosmetic and psycho-developmental outcomes. While a variety of cranial vault expansion techniques are described in literature, debate continues regarding the relative efficacy of these procedures in achieving acceptable long-term outcomes.

Methods: Here, we describe a five-year, retrospective, single institution experience of surgical outcomes in pediatric patients undergoing open strip craniectomy for non-syndromic sagittal synostosis. Analysis included length of surgery, length of hospital stay, blood loss, infections and need for re-operation. Follow-up data included helmet use and morphometric cranial indices. Statistical analysis was done using Student's paired t-test with significance level set at <0.05.

Results: Forty-four patients with a mean age of 5 months (range 2-15 months) were included. Over eighty percent of patients were older than 3 months with a male predominance of 4:1. Mean length of surgery was 45 minutes (15-100 minutes), while mean length of hospital stay was 3 days (range 2-5 days). Mean surgical blood loss was 24cc with a transfusion rate of 6.8%. One third of patients were lost to follow-up with a mean follow-up in the rest of 18.8 months. The average helmet use was 4.6 months with a significant improvement in cranial morphometric index (p=0.001) on last follow-up.

Conclusions: Strip craniectomy is a safe and effective treatment for single-suture sagittal synostosis with minimal complications even for patients older than 3 months. All patients with available follow-up data showed excellent cosmetic result and correction of cranial morphometric indices.

180. Multidisciplinary Approach for the Treatment of Pediatric Triton Tumor

Edward Robert Smith, MD, FAANS; John Meara, MD; Reza Rahbar, MD; Raj Thakrar, MS (Boston, MA)

Introduction: Triton tumors are extremely rare neoplasms of variably differentiated neural and skeletal muscle tissue. They often develop around peripheral nerve trunks, but are rarely reported in children and are markedly uncommon intracranial lesions. We report our experience with a Triton tumor in a 4 year-old girl, highlighting the rarity of this intracranial presentation, coupled with what we believe to be the largest Triton tumor reported to date, requiring a custom multidisciplinary approach for successful resection.

Methods: Case report.

Results: A four-year-old child presented with a right-sided facial mass and trismus. Imaging revealed a large, 3.2x2.3x2.9 cm complex mass of the right infratemporal fossa, invading the foramen ovale and extending into the middle and posterior fossa of the CNS. The lesion was partially enhancing, invaded adjacent infratemporal musculature, was associated with marked overgrowth of the right coronoid process and also had bony erosion of the middle fossa. After needle biopsy, a multidisciplinary team, including plastic surgery, otolaryngology and neurosurgery, performed a combined, multi-step single day surgical approach for resection. Unique to this case was the resection of the coronoid process, modified middle fossa intra- and extra-dural approach, coupled with a transfacial infratemporal approach. The child did well, with 100 cc blood loss and postoperative return of function to her ability to chew.

Conclusions: Triton tumors are exceedingly rare in children with awareness of the diagnosis helpful for prognostic and therapeutic planning. This case highlights a novel multidisciplinary surgical approach and illustrates the challenges unique to this tumor type, potentially the largest reported to date.

181. Myelomeningocele: time to closure- the experience of one national centre

Tafadzwa Mandiwanza; Robyn Patrick; Shari Ramsaran; Chandrasekaran Kaliaperumal; Muhammed Sattar; John Caird; Darach Crimmins (Dublin 1, Ireland)

Introduction: Neural tube defects are challenging congenital malformations with spina bifida and anencephaly being the commonest variants. The cornerstone of myelomeningocele management is surgical closure. The timing of this closure has been a topic of debate with British guidelines recommending closure within 48 hours of life to prevent wound and shunt complications. Our objective was to assess our closure times and shunt or wound complication rates in our myelomeningocele patients.

Methods: A retrospective review of patients with myelomeningocele referred to our unit from January 2008 to July 2013. Our unit became the national centre for pediatric neurosurgery in 2008 hence all live births with neural tube defects were referred to us. Medical records were reviewed for demographic data and information on admission dates, time to closure, method of closure (fasciocutaneous flaps or not), shunt insertion and interval between lesion closure and shunt insertion. Complications including wound infection/ dehiscence, CSF infection, meningitis and shunt infection was recorded.

Results: 102 patients were included, 58 female, 44 male with a majority of lumbosacral lesions. 41% (42/102) were closed within 48 hours of birth, 16% were closed after 48 hour but within 72 hours of birth and 41% were closed after 72 hours, while 2 lesions were not closed. The overall shunt rate was 77% (79/102) with a mean 12 days between lesion closure and shunting and 9 shunts were inserted simultaneously. The shunt infection rate was 28% (22/79), wound complication rate was 32% (33/102), CSF leak rate 34% (35/102) and meningitis rate was 14%. The most shunt infections (41%) and meningitis (50%) occurred in the <72 hour group, while the most wound complications (48%) and CSF leaks (43%) occurred in the 48 hour group.

Conclusion: Our data suggests that there is no great advantage, in terms of wound complication and shunt infection, to closure of myelomeningocele within 48 hours. Our numbers are small and this topic would benefit from a multi-centre randomised control trial.

182. National trends, complications, and outcomes following surgery for Chiari Malformation

Doniel Gabriel Drazin, MD; Doniel Drazin, MD; Faris Shweikeh, BA; Holly Dickinson, BA; Miriam Nuno, PhD (Los Angeles, CA)

Introduction: Management of the common neurosurgical condition, Chiari Malformation (CM), remains controversial. The literature reports pros and cons for posterior fossa decompression (PFD) versus PFD with duraplasty (PFDD). Our aim was to analyze and report on both treatment modalities after accessing a national database.

Methods: Using Kids' Inpatient Database (KID) for years 2000, 2003, 2006, and 2009, patients with a primary diagnosis of CM that underwent posterior fossa

decompression with (PFDD) and without (PFD) duraplasty were identified using ICD-9 codes. Our retrospective analysis looked at patient characteristics and operative procedures.

Results: Number of surgeries did not change significantly from year to year (range: 688-748cases/year). The 2,934 identified cases were: 90.3% type I, 9.7% type II, 61.8% PFD, 38.2% PFDD. The male-to-female ratio was near 1:1, mean age 10.0 ± 0.02 years. Most patients were white (77%) with private insurance (68.2%). 87% were elective operations versus 12.4% emergent. A C1 laminectomy was performed in approximately 45% of all cases without significant differences in PFD and PFDD groups. Of 20% with syringomelia, 52.8% had PFD versus 47.2% PFDD (p=0.002). Length of hospital stay (LOS) was 4 days for PFD group, 4.5 days for PFDD (p=0.02). There were 40 reoperations: 25(2.2%) in PFDD group, 15(0.81%) in PFD group (p=0.0003). Multivariate logistic regression demonstrated that complications were more likely in the PFD group.

Conclusions: Incidence of operative CM cases has been stable. PFDs outnumbered PFDDs. Type 2 patients were less likely to have PFDD and upper cervical laminectomy was less likely to be included. Contrary to common beliefs, the majority of CM patients with syringomelia were not treated with PFDD, though it comes to about half the cases. Although LOS was significantly higher in PFDD patients, it only differed by 0.5 days. Overall, a small number of reoperations resulted, with a significantly higher number in the PFDD group, in line with previous reports. Reviewing statistics from national databases will help inform providers as they decide their CM patient's treatment.

183. Natural History of Pediatric Syringomyelia

Analiz Rodriguez, MD; Aravind Somasundaram, BS; Elizabeth Kuhn, BSE; Daniel Couture, MD (Winston Salem, NC)

Introduction: Syringohydromyelia is frequently identified on spinal imaging, but the natural history is not well defined. The literature provides little guidance to decision making regarding the need for followup or treatment. We retrospectively review pediatric patients with syringohydromyelia.

Methods: A retrospective review of all pediatric patients who underwent spinal magnetic resonance imaging from 2002 to 2012 was conducted. Patients with syringohydromyelia that was idiopathic or associated with scoliosis or possible tethered cord syndrome (TCS) were identified. Clinical and radiographic data were analyzed.

Results: 105 patients (52 female, 53 male) met the inclusion criteria. Average age at diagnosis of syrinx was 9.3 years. Average syrinx size was 3.1mm and spanned 7 vertebral levels. 40% of patients had scoliosis and 12% had tethered cord symptoms. The most common presenting complaint was pain (28%). 59% had clinical follow-up with an average time of 52 months. Only 15% of patients (12% with scoliosis and 25% with tethered cord) had a neurologic deficit at presentation (81% with extremity weakness). 69% of these patients had resolution of these deficits at last follow-up. 43 patients had radiographic follow-up (average time: 22 months). 84% had no change in syrinx size, 9% had a decrease and 7% had an increase in size. 8 patients required surgical intervention to treat symptomatic lesions. Of the operative subpopulation, 6 had no change in syrinx size. One patient had a decrease in syrinx size and one had an increase in syrinx size.

Conclusions: Clinical observation without surgical intervention of pediatric patients with asymptomatic syringohydromyelia associated is appropriate initial management.

184. Natural history of ambulation in myelomeningocele

Jeffrey Pugh, MD; Vanessa Rogers (Edmonton, Canada)

Introduction: Although deterioration in ambulation over time has been recognized in clinical practice and briefly mentioned in spina bifida literature, few studies have set out to investigate the natural history of ambulation in patients with myelomeningocele.

Methods: Retrospective review of 32 pediatric patients and 16 adolescent patients with myelomeningocele. Preferred method of ambulation at ages 5, 10, and 15, as well as early and recent functional motor levels were recorded from these 48 charts.

Results: 36 patients had undergone a 5-year follow up, at which time 24 could walk with or without aids/orthotics (66.7%). Of 25 patients with 10-year follow ups, 1 showed deterioration in walking ability compared to the 5-year visit. 9 patients had completed 15-year follow up visits, 3 of which showed deterioration of walking since their 10-year visit. Overall, 4/16 adolescents experienced deterioration in their walking abilities (25%). Patients were stratified based on anatomical levels into the following 5 groups: L2 and higher (12 patients), L3 (6), L4 (13), L5 (10), and S1 and lower (7). Our group of 48 patients consisted of 15 wheelchair users (31.25%), 25 patients who could walk (52.1%), 5 were likely to walk (10.4%), and 3 were unlikely to walk (6.25%). Of patients with anatomical levels L3 and above, 11 used a wheelchair (61%), 3 could walk (17%), 2 were likely to walk (11%), and 2 were unlikely to walk (11%). Of patients with anatomical levels L4 and lower, 4 patients used a wheelchair (13%), 22 could walk (73%), 3 were likely to walk (10%), and 1 was unlikely to walk (3%).

Conclusions: Deterioration in walking ability was most likely to occur during adolescence. All patients who experienced deterioration in their walking ability had anatomical lesion levels equal to or above L4, and functional levels higher than or equal to L3. Furthermore, fewer patients with lesions above L4 were community ambulators, while all but one patient with lesions lower than L4 could walk or was expected to walk.

185. Non-accidental Head Injuries in infants: Comparison of long term outcomes between surgical and non-surgical interventions.

Amir Kershenovich, MD; Oscar Malo-Macias, MD; Shelly Timmons, MD; Paul Bellino, MD (Danville, PA)

Introduction: There are relatively few studies reporting short and long term outcomes for non accidental head injury (NAHI) in infants in modern English literature. Neurosurgical intervention is required for some. To our knowledge, there are no reports of the impact and predictive outcome value of surgical interventions. The aim of the study was to compare the short and long term outcomes of infants with NAHI who underwent or not neurosurgical interventions.

Methods: A retrospective chart-based review analysis was conducted based on NAHI cases found in the Geisinger Health System Trauma database between January 31, 1992 and January 31, 2012. For analysis purposes patients were divided into two surgical groups, two admision glasgow coma scale (GCS) groups (severe: GCS 3-8; minor-moderate: GCS 9-15), and two outcome groupes (severe neurological deficit and mild neurological deficit).

Results: 120 patients were identified and 119 analyzed. One was excluded since there was no chart to review. Mean age was 6.2 months old at admision, (range 17 days-24 months). Follow up was available for 77 patients (mean: 32 months, range 1-132 months). The pepetrator was unknown in 51 cases. Surgical intervention was considered as any invasive procedure to drain, evacuate, decompress or monitor ICP. Forteen craniotomies/craniectomies were performed, 5 bolts inserted, one ventriculostomy, 2 shunts, 9 external drains, 6 fontanelle taps and two lumbar punctures in 33 patients. 6 patients had more than one procedure done. All 16 deaths occurred withing the severe GCS groups. In the severe GCS group, 75% died if no surgical intervention was performed, compared to 41.2% if a procedure was performed. In the minor-moderate GCS group, a severe neurological deficit occurred more if a surgery was required compared to not requiring one. In the severe GCS group, surgery did not decrease the chances of having a severe deficit.

Conclusions: Surgical intervention in infants with NAHI decreases mortality; it doesn't decrease the probability of having a severe neurological deficit if the admision GCS is poor, and it increases that probability if surgery was required among those with minor to moderate GCS.

186. Novel assessment tool for adolescent sports-related concussion: Measurement of cerebrovascular reactivity using provocative CO2 challenge during blood oxygen level dependent (BOLD) magnetic resonance imaging.

Michael John Ellis, MD FRCSC; Lawrence Ryner; Jeff Leiter, PhD; Ruth Graham, MD; Vincent Wourms, MD; Roshan Raban, MD; David Mikulis, MD, PhD; Joseph Fisher, MD, PhD; W. Alan Mutch, MD, PhD (Winnipeg, Canada)

Introduction: There is an urgent need for novel diagnostic neuro-imaging biomarkers that can discriminate between acute and recovered stages of sports-related concussion. Although impairments in cerebral blood flow (CBF) and cerebrovascular reactivity (CVR) are important predictors of poor outcome in pediatric severe traumatic brain injury, their impact on adolescent sports-related concussion remains unknown.

Methods: We present a 19-year old male hockey player who sustained a concussion following a high-velocity body-check. Nine months later the patient continued to complain of blurred vision following exertion during non-contact hockey and aerobic exercise testing. The patient underwent anatomical, blood oxygen level-dependent (BOLD) magnetic resonance (MR)-imaging, infrared cerebral oximetry and non-invasive hemodynamic monitoring during iso-oxic model-based prospective end-tidal (MPET) CO2 targeting 10mmHg above and below the patient's resting ETCO2.

Results: Anatomical MR-imaging was normal. MR-imaging during MPET CO2 targeting demonstrated profound asymmetries in fronto-parietal regions of interest (ROIs) with altered CVR in the right ROI compared to the left. Hemispheric asymmetries in cerebral oxygenation were also observed during the hypercapnic phase of the study consistent with MR-imaging findings.

Conclusions: Characterization of global and regional abnormalities in CVR during MPET CO2 targeting with BOLD MR-imaging has the potential to serve as a reliable biomarker for recovery in adolescents with sports-related concussion. Prospective studies examining the relationship between symptom inventories, neuro-cognitive profiles, and cerebrovascular parameters (CVR, CBF, cerebral oximetry) using this novel assessment paradigm are currently underway at our institution.

187. Occult Brain Arteriovenous Malformations Presenting as Intraparenchymal Hemorrhage in Children

Travis Ryan Ladner; Lori Jordan; Luke Tomycz; Robert Singer (Nashville, TN)

Introduction: Brain arteriovenous malformations (AVMs) are the most common cause of non-traumatic intraparenchymal hemorrhage (IPH) in children. However, small AVMs often go unrecognized in the acute period, despite conventional catheter angiography (CCA), as a consequence of hematoma compression and post-bleed dynamic flow changes. We review 2 cases of pediatric occult AVMs who presented with IPH. In both cases an occult AVM or occult residual AVM was identified months later with CCA, and each was resected without incident.

Methods: Case 1: A 6-year-old boy presented with left frontal IPH on head CT. CCA 5 days post-bleed did not reveal the source lesion. The patient was followed with MRI at 3 months post-bleed, which was not diagnostic for AVM. Case 2: A 12-year-old girl presented with a right frontal IPH on head CT. The hematoma was evacuated and an AVM was resected. Intraoperative CCA did not demonstrate any residual AVM.

Results: Case 1: At 4 months post-bleed, CCA demonstrated a small left frontal AVM, which was subsequently resected. Case 2: At 2 months post-bleed, CCA demonstrated a residual AVM, which was resected 2 weeks later. At one-year follow-up, neither patient has had any new neurological symptoms.

Conclusions: When the etiology of an IPH is unknown in children or when an AVM is treated in the acute period, repeat CCA should be considered in the convalescent period when post-ictal mass effect and hemodynamic changes have subsided. This allows for enhanced visualization of the source lesion, and in these two cases was essential to guiding treatment decisions.

188. Of course parents are anxious during their child's neurosurgery - the question is what can we do about it?: a prospective qualitative and quantitative study

Ashutosh Singhal, MD, FRCSC; Alexander Hengel, BS (Vancouver, Canada)

Introduction: Pediatric Neurosurgery is associated with significant anxiety for caregivers. While preoperative and postoperative anxiety is well studied, there is little literature on anxiety during the procedure itself. If identified, common themes may provide insights that assist the Neurosurgical team in allaying anxiety during procedures.

Methods: We interviewed caregivers of pediatric patients undergoing neurosurgery at our institution. Procedures were done by the first author, and were generally epilepsy surgery patients. Interviews were conducted mid-way through scheduled operations, with a semi-structured, open-ended format to assess qualitative information about goals, concerns, fears and expectations of caregivers waiting for a child during surgery. The State-Trait Anxiety Inventory (STAI) Questionnaire was used to quantitatively assess parental anxiety level.

Results: Caregivers of 10 children were formally interviewed. Situational anxiety was markedly elevated (p

Conclusion: Caregivers have high anxiety levels during procedures. Our results suggest that by providing families with status updates, realistic surgical time-frames, and access to preoperative specialty nurses, institutions can potentially reduce anxiety experienced by caregivers in the waitroom.

189. Optical Coherence Tomography (OCT) Use in Assessing Pediatric Hydrocephalus

Steven W. Hwang, MD; Marisa Gobuty, MD; Carl Heilman, MD; Geetha Athappilly, MD; Thomas Hedges, MD (Boston, MA)

Introduction: OCT, often used by ophthalmologist, provides a quantitative measure of retinal nerve fiber layer (RNFL) thickness, which has shown to be increased in patients with papilloedema, a symptom often found in patients with hydrocephalus and increased intracranial pressure. We hypothesize that OCT may have greater sensitivity and specificity in detecting hydrocephalus and shunt malfunctions and sought to investigate its applicability.

Methods: This is a prospective cohort study at a single institution. All pediatric patients between the ages of 4 and 18 assessed for routine follow-up or acute evaluations of hydrocephalus or shunt malfunctions were enrolled and underwent OCT imaging.

Results: 6 patients are enrolled to date with an average age of 13.3 years. Four were female and two male. Diagnoses included: congenital hydrocephalus, chiari malformation, brain tumor, and pseudotumor. One patient had a new diagnosis of hydrocephalus with papilloedema. Two patients had questionable shunt malfunctions without papilloedema. The patient with a new diagnosis of hydrocephalus had RNFL measurements of OD - 167µm, OS - 182µm one day post ETV surgery, OD - 175µm OS - 195µm two days post surgery, and OD - 163µm, OS - 154µm two weeks post surgery. Baseline average RNFL thickness measurements for three patients without known optic atrophy were: 80.83 ± 6.91µm and with optic atrophy: 65.25 ± 9.91µm.

Conclusion: Our preliminary data suggests that OCT may be a valuable tool to quantitatively assess papilloedema and shunt malfunction in patients with hydrocephalus, but requires significant more investigation.

E-POSTER ABSTRACTS

190. Orthotic (Helmet) Therapy in treatment of plagiocephaly

Jo Ling Goh; David Bauer, MD; Susan Durham, MD, MS; Mitchell Stotland, MD, MS (Lebanon, NH)

Introduction: The goal of this study is to review the current literature on orthotic (helmet) therapy use in treatment of deformational plagiocephaly.

Methods: PubMed was used to search English articles with MeSH terms: Deformational plagiocephaly and orthosis; Deformational plagiocephaly and helmet.

Results: Forty one articles were found. There were no Class I studies, seven class II studies, one class III study, and 12 class IV studies. Cranial orthoses have been shown to be effective in treating deformational plagiocephaly. It is debated whether the statistical significance of treatment with cranial orthoses versus conservative therapies is clinically significant. Children above 12 months of age with deformational plagiocephaly may still benefit from orthotic therapy. The long-term effects of orthotic therapy are controversial.

Conclusions: There is a lack of Class 1 literature supporting the use of helmet therapy in deformational plagiocephaly. There are controversies surrounding the use of orthotic therapy such as appropriate use, cost, use in older children, and long term outcomes. Clinical indications for orthotic therapy need to be better defined with further research studies.

191. Osteosarcoma of the Cranial Vault and Skull Base in Children: Case Series and Literature Review

Robert Bollo, MD; Caroline Hadley, BS; Loyola Gressot, MD; Akash Patel, MD; Lisa Wang, MD; Ricardo Flores, MD; William Whitehead, MD; Thomas Luerssen, MD; Andrew Jea, MD (Houston, TX)

Introduction: Osteosarcoma involving the calvarium and skull base is uncommon. Devising the optimal treatment of these tumors is difficult given the low incidence. We report three unique cases of cranial osteosarcoma in children.

Methods: Case series and literature review.

Results: Case 1: A 14 year old boy presented with a rapidly enlarging, painful swelling of the parietal calvarium and was found to have a 4.9 cm expansile osseous lesion. The patient underwent craniectomy for resection of osteoblastic osteosarcoma followed by chemotherapy. He has no evidence of disease at follow up. Case 2: A 14 year old boy with primary osteoblastic osteosarcoma of the femur treated with limb sparing surgery and chemotherapy developed a calvarial metastasis. This was resected, but 3 months off therapy, he developed a large recurrent skull lesion. This was re-resected but tumor was found to have eroded through dura and involve the superior sagittal sinus. He is alive but with progressive systemic disease at follow-up.Case 3: A 14 year old boy presented with proptosis, visual symptoms and epistaxis and was found to have extensive tumor involving the anterior skull base, nasopharynx and adjacent air sinuses. Biopsy showed a chondroblastic osteosarcoma. He received neoadjuvant chemotherapy and underwent subsequent resection, followed by radiation. He has no evidence of disease at follow up.

Conclusions: Our series as well as a literature review illustrate the variability in presentation of skull osteosarcoma and emphasizes the importance of maximal surgical resection and a multidisciplinary approach to management.

192. Outcome of Chiari I Malformation Decompression without Duraplasty in a Pediatric Population

Tong Yang, MD; Stephanie Da Silva, BA; Mark Krieger, MD; J McComb, MD (Los Angeles, CA)

Introduction: In addition to a bony decompression, various modifications are incorporated to treat patients with a Chiari I malformation. We previously reported a simpler method of craniocervical decompression wherein the dura mater is not closed thereby avoiding a duraplasty. This report is a follow up of our more recent experience using the previously described technique.

Methods: With Institutional Review Board (IRB) approval, records of patients undergoing a craniocervical decompression at a single institution from 1/12002 to 12/31/2012 were reviewed. All patients were operatively treated in a similar fashion with the dura approximated but not closed. The cerebellar tonsils were not resected nor shrunk, and stents were not used.

Results: Identified were 123 patients with a median age of 102 months (8-238 months) with a male to female ratio of 58:65. The median follow up was 28 months (1-123 months) with 16 patients lost to follow up. At presentation, 109 patients had hydrosyringomyelia or hydrocephalus, 65 had scoliosis, 32 had neurological deficits, and 34 had headaches. Postoperatively the syrinx decreased in 73, was unchanged in 21, and enlarged in 7. Out of those patients with stable but large, recurrent or worsening syrinx, 8 patients required 2nd surgery, and one patient required 3rd surgery. Five patients had CSF leak requiring operative intervention. No bacterial meningitis was seen. No new neurological deficit occurred.

Conclusions: Our recent experience validates our initial approach to a simpler craniocervical decompression to treat a pediatric population with Chiari I malformation.

193. Patient characteristics and clinical decision making in the pediatric traumatic brain injury patient population: an institutional review

Chevis Shannon, MBA, MPH, DrPH; Katherine Kelly; Kelly Pekala, MS; James Leathers; Amber Greeno, RN; Purnima Unni; John Wellons, MD; Noel Tulipan, MD (Nashville, TN)

Introduction: The purpose of our study was to retrospectively evaluate patient characteristics and factors influencing clinical decision making in an effort to inform an ongoing discussion centered on standardization of treatment and management for traumatic brain injury (TBI) patients.

Methods: A retrospective study of 1836 children undergoing treatment and management for TBI between January 2006 and April 2013 at the Vanderbilt University Children's Hospital was conducted. Descriptive statistics, multivariate and logistic regression were conducted using SAS 9.3.

Results: We found that 63% of our cohort was male, 77% were Caucasian, and over 75% presented alert and were discharged home. The mean age was 7.6 years (stdev 5.83). Approximately 50% of our cohort required ICU days of 3 or less while 40% required greater than 14 days in the ICU. Bleed characteristics including epidurals, subdurals, subarachnoid hemorrhage, and radiographic characteristics including bilaterality of bleeding, retinal hemorrhage and midline shift were evaluated. Of these factors, subdurals, epidurals, age, and low GCS were associated with ICU stays of 7 days or greater ($p<.0001$) Additionally, prolonged seizure activity, high glucose levels and subdural hematomas were found to be associated with hospital disposition other than home ($p< .0001$).

Conclusion: The purpose of this study was to retrospectively review our institution's trauma patient population as a step towards standardization of clinical care. This descriptive study will inform a TBI protocol and multidisciplinary clinical pathway that will be used among the pediatric neurosurgery, emergency department and critical care teams at VCH.

194. Pediatric Endoscopic Third Ventriculostomy outcomes: a population-based study.

Sandi K. Lam, MD; Dominic Harris, BA; Brandon Rocque, MD, MS; Rena Conti, PhD (Chicago, IL)

Introduction: Endoscopic third ventriculostomy (ETV) is an alternative to ventriculoperitoneal shunting (VPS) for hydrocephalus treatment. Studies have examined ETV success. We performed the first population-based analysis of ETV outcomes using an administrative claims database, examining current practice for pediatric patients in the US.

Methods: We queried the Truven Health MarketScan® database for CPT codes corresponding to ETV and VPS from 2003-2011, including patients <19 years and collecting data from initial and subsequent hospitalizations. Hydrocephalus etiology was classified with ICD-9 coding. ETV failure was defined as any subsequent ETV or shunt procedure.

Results: 480 patients underwent ETV. 46% were female. Mean age was 8.8 years (83 patients <12 months, 162 1-9 years, 235 10-19 years). Mean follow-up was 1.5 (SD1.7) years. Etiology of hydrocephalus was 41.7% tumor, 22.3% congenital/aqueductal stenosis, 5.4% hemorrhage, 3.8% myelomeningocele, 26.5% obstructive - not specified. ETV was successful in 71% of patients, with 339/480 not having subsequent surgery. Of the 141 who failed, 34 (24%) had repeat ETV and 107 (76%) had shunt placement. Patients <1 year had a significantly lower rate of ETV failure than those aged <12 months. (HR0.4, 95%CI 0.26-0.6). Hydrocephalus coded as obstructive NS was associated with lower failure. Mean time to failure was 112.8 days (SD 238); median was 24 days.

Conclusion: This study represents a cross-section of nationwide ETV practice over 9 years. Success rate is similar to that published by academic pediatric neurosurgery centers.

195. Pediatric Familial Moyamoya in a North American Case Series

Edward Robert Smith, MD, FAANS; Elizabeth Kwak; Sunil Manjila, MD; R. Michael Scott, MD (Boston, MA)

Introduction: It is unclear whether familial moyamoya in a North American pediatric population is similar to other locations.

Methods: Retrospective single center IRB-approved review of a series of 457 pediatric patients (age <21 years) with moyamoya from 1985-2013. Familial cases were defined as individuals with a sibling, parent or aunt/uncle who were also diagnosed with moyamoya.

Results: Eighteen patients, 4% of the series (8 M/10 F, mean age 7.4, range 2-20 years) were identified. Ethnicity was 67% Caucasian (12/18), with 3 sets of twins, 8 non-twin siblings and 4 with affected parents or aunt. Interestingly, 2 other patients in the series of 457 had identical twins without moyamoya. Presentation was predominantly symptomatic with ischemia (TIA, stroke) in 61% (11/18). Only one patient 6% (1/18) had moyamoya identified after screening because of an affected relative. Radiographically, 6 patients had unilateral disease (33%) and 7/18 had radiographic stroke. Seventeen patients underwent pial synangiosis, (29 hemispheres), with no perioperative strokes. Average follow up was 3.2 years (range 1-9 years). All patients remain stroke-free clinically and radiographically, with one-year post-operative angiograms demonstrating Matsushima grades A collateral in 85% (11/13) of studied hemispheres.

Conclusions: Familial moyamoya was present in 4% of a North American series of pediatric patients. Age, sex distribution and ethnicity mirrored the series population as a whole, as did presentation, imaging and response to surgery. Interestingly, 3 sets of twins shared moyamoya, while two other sets of identical twins did not share moyamoya, suggesting that a combination of genetic and environmental triggers induce disease onset.

196. Pediatric Head Trauma-A Decline in Numbers. A Retrospective Review.

Jerome Milton Volk, MD; Frank Culicchia, MD (New Orleans, LA)

Introduction: When it comes to trauma admissions, pediatric trauma is a very complex section. Many different disciplines are required throughout the patient's admission. Therefore, it is an integral part of any neurosurgical training program to be exposed to pediatric trauma. Some authors have reported a decline in numbers of pediatric head trauma around the country. The goal of this paper is to report on the pediatric head trauma statistics at the Level I Trauma Center in New Orleans.

Methods: Data provided from the Medical Center of Louisiana-New Orleans Trauma registry from the years 1999-2009 was compiled. Children (less than 16 yrs) were included that were met criteria for trauma activation were included. The years of 2005 and 2006 were excluded secondary to the trauma center being closed due to Hurricane Katrina. Annual rates of trauma admissions were evaluated and stratified according to head trauma, outcome, penetrating versus blunt injury.

Results: Reviewing the data from 1999-2009 the annual number of pediatric trauma admission has dramatically decreased from 300-400 patients between 1999-2004 to 50-70 patients between 2007-2009. Exploring this data further the incidence of head trauma decreased from 100-150 patients between 1999-2004 to 10-20 patients from 2007-2009. However, the percentage of deaths per year secondary to trauma increased from 2-3% from 1999-2004 to 8-15% from 2007-2009 (with head trauma accounting for 18-30% of deaths). Also the percentage of penetrating trauma increased from 3-10% between 1999-2004 to 50% between 2007-2009.

Conclusions: Over the course of ten years there has been a large drop in the amount of pediatric trauma seen at the Level I Trauma Center of New Orleans (Charity Hospital/University Hospital). One big reason for this could be secondary to population shifts after Hurricane Katrina. The point of this study was to point out this drop in statistics. From this study, we plan to expand the data and find out the reason for this decline.

197. Pediatric Mesencephalic Tectal Plate Gliomas: Clinical , and Radiologic Progression, MR Imaging Characteristics, and Management of Hydrocephalus

Brandon Rocque, MD; Joseph Hardy Miller, MD; Christoph Griessenauer, MD; Elias Rizk, MD; Philip Hendrix, MD; R Tubbs, MD; Mark Dias, MD; Jeffrey Blount, MD; Joshua Chern, MD (Birmingham, AL)

Introduction: The management of pediatric tectal plate gliomas remains controversial. Treatment options include observation, radiotherapy following biopsy, and surgical resection.

Methods: A cohort of patients with tectal gliomas at two academic institutions was retrospectively reviewed.

Results: Forty-four patients (mean age of 10.2 years) with tectal gliomas were included in the study. The mean clinical and radiographic follow-up was 7.6 years and 6.5 years, respectively. The most frequent intervention was CSF diversion (81.8% of patients) followed by biopsy (11.4%), radiotherapy (4.5%), chemotherapy (4.5%), and resection (2.3%). On MR imaging tectal gliomas most commonly showed T1-weighted isointensity (71.4%), T2-weighted hyperintensity (88.1%), and rarely enhanced (19%). Initial average volume was 1.6 cm3 and increased to 2.0 cm3 ($p = 0.628$) at the last follow up. Frontal to occipital ratio (FOR) and 3rd ventricular width statistically decreased over time ($p < 0.001$ and $p < 0.05$, respectively).

Conclusions: Our results support existing evidence that tectal gliomas have an indolent clinical and radiographic course and rarely require any intervention beyond management of hydrocephalus.

198. Predictive Value of Cerebrospinal Fluid Cytochemistry in Bacterial Shunt Infection

Libby Marie Kosnik-Infinger, MD MPH; Edward Kosnik, MD (Charleston, SC)

Introduction: A febrile syndrome in a shunted patient raises the question of the presence or absence of shunt infection. We aimed to establish if one can rely on initial CSF sampling in the prediction of the presence or absence of shunt infection defined by positive culture.

Methods: Two groups of shunted patients had CSF sampled, those with no shunt infection (N=95), and those with culture positive CSF infection

(N=40). The data had been previously collected and this was a retrospective review. Descriptive statistical analysis including means, standard deviations, and ranges were established. The different categories of one group were tested against corresponding categories in the other group using the Mann-Whitney U-test corrected for large populations. Multivariant analysis of variants and discriminant statistical analysis was performed.

Results: Only the RBC values were not statistically significant. All other values were highly significant. However, examination of the graphic tabulations show that there are areas of overlap for all values considered. Only 52.5% of infected patients were correctly classified as infected based on the values of the initial CSF. The other 47.5% of infected patients were misclassified as non-infected when they were infected. Only 5.25% of non-infected patients were incorrectly classified as infected.

Conclusions: Based on these results, CSF cytochemistry cannot accurately predict the presence or absence of a shunt infection. A febrile shunted patient with no other obvious source of infection should be presumed to harbor a shunt infection until otherwise proven by negative culture results.

199. Predictors of Prolonged Recovery Following Sports Related Concussion: A Single Center Retrospective Study

Clarence Gill; Joseph Miller, MD; Jilian Neimann; Steven Brown; Marshall Crowther; Drew Ferguson; James Johnston (Madison, AL)

Introduction: Previous studies have found that initial symptom severity and diagnosis of ADHD are predictors of prolonged recovery (<28 days) or disability following sports related concussion.

Methods: This was a single center retrospective cohort study of patients cared for at the multidisciplinary Concussion Clinic at Children's of Alabama between 2011-2013. Selected predictors of prolonged recovery following concussion were compared in 2 groups: those whose symptoms resolved within 28 days and those whose symptoms persisted beyond 28 days. Candidate predictor variables were then analyzed using JMP statistical software (SAS Institute, NC).

Results: A total of 297 patients met the inclusion criteria during the study period. There was no significant difference in age between the brief and prolonged symptom cohorts (p = 0.69). Previous history of concussion (RR 1.73, 95% CI 1.17-2.56), presenting SCAT2 score <80 (RR 2.89, 95% CI 1.9-4.2), higher presenting SCAT2 symptom severity score (p<0.001), previously diagnosed ADHD (RR 2.02, 95% CI 1.03-3.99) and female gender (RR 2.29, 95% CI 1.57-3.35) were all associated with a higher risk of post-concussive symptoms lasting more than 28 days. Loss of consciousness, amnesia, balance abnormalities, and a history of migraines were not associated with prolonged symptoms beyond 28 days.

Conclusions: This large retrospective dataset suggests candidate risk factors for prolonged recovery following sports concussion. Large prospective cohort studies will be needed to definitively establish these associations and confirm which children are at highest risk of prolonged recovery.

200. Presigmoid, transtentorial posterior petrosal approach to pontine cavernous malformation in a 3 year-old

Daniel H. Fulkerson, MD FAANS; William Kemp, BS; Troy Payner, MD (Indianapolis, IN)

Introduction: Children with brainstem cavernous malformations have a high risk of hemorrhage and neurological deterioration. The surgical management of these lesion is challenging. The authors describe the application of an adult skull base approach to a ventrolateral pontine lesion in a 3 year-old child. This approach, to our knowledge, has not been described in a child this young.

Methods: We review the imaging, clinical history, and operative technique.

Results: The cavernous malformation was resected. The child did well clinically. She had no new neurological deficits. Her pre-operative hemiparesis improved after surgery.

Conclusions: The posterior petrosal skull base approach may be performed safely in very young children. Pediatric neurosurgeons should be aware of this approach when treating challenging brainstem lesions.

201. Prevalence of neurobehavioral, social, and emotional dysfunction in patients treated for childhood craniopharyngioma: A systematic literature review

Eisha Christian, MD; Frank Attenello, MD; Natalie Kintz, BA; Mario Pulido, MS; Lilyana Amezcua, MD; Gabriel Zada, MD (Los Angeles, CA)

Introduction: Craniopharyngiomas (CP) are locally invasive and frequently recurring neoplasms often resulting in neurological and endocrinological dysfunction in children. In addition, social-behavioral impairment is commonly reported following treatment for childhood CP, yet remains to be fully understood. The authors aimed to further characterize the prevalence of neurobehavioral, social, and emotional dysfunction in survivors of childhood CP.

Methods: A systematic literature review was conducted in PubMed to identify studies formally assessing neurobehavioral, social, and emotional outcomes in patients treated for CP prior to 18 years of age. Studies published between the years 1990-2012 that reported the primary outcome (prevalence of neurobehavioral, social, emotional/affective dysfunction, and/or impaired quality of life (QOL)) in ≥10 patients were included.

Results: Of the 471 studies screened, 11 met inclusion criteria. Overall neurobehavioral dysfunction was reported in 51 of 90 patients (57%) with available data. Social impairment (i.e. withdrawal, internalizing behavior) was reported in 91 of 222 cases (41%). School dysfunction was reported in 48 of 136 patients (35%). Emotional/affective dysfunction was reported in 58 of 146 patients (40%), primarily consisting of depressive symptoms. Health related QOL was affected in 49 of 95 patients (52%). Common descriptors of behavior in affected children included irritability, impulsivity, aggressiveness, and emotional outbursts.

Conclusions: Neurobehavioral, social, and emotional impairment is highly prevalent in survivors of childhood CP, and often affects QOL. Thorough neurobehavioral/emotional screening and appropriate counseling is recommended in this population. Additional research is warranted to identify risk factors and treatment strategies for these disorders.

202. Withdrawn

203. ROUTINE USE OF RECOMBINANT HUMAN BONE MORPHOGENETIC PROTEIN-2 IN POSTERIOR FUSIONS OF THE PEDIATRIC SPINE AND INCIDENCE OF CANCER

Christina Mieko Sayama, MD, MPH; Matthew Willsey, BS; Alison Brayton, RN; Valentina Briceno, RN; Sheila Ryan; Thomas Luerssen, MD; Andrew Jea, MD (Houston, TX)

Introduction: There are concerns regarding the off-label supplementation of autologous or allograft bone graft with rhBMP-2 in pediatric spine fusions. These include the possibility of bony overgrowth, systemic toxicity, local toxicity, immunogenicity, osteoclastic activation, and effects on distal organs; the most serious concern has been the implication of BMP in the development of new cancers. The purpose of this study is to determine the safety of recombinant human bone morphogenetic protein-2 (rhBMP-2) use in posterior instrumented fusions of the pediatric population, focusing on cancer risk. We report our long-term results with a minimum of 24-months followup.

Methods: A retrospective review of 57 consecutive pediatric patients who underwent posterior occiptocervical, cervical, thoracic, lumbar, or lumbosacral spine fusion from October 1st, 2007 to June 30th, 2011 at Texas Children's Hospital was performed. 12 patients were excluded from further analysis because of loss of follow-up or follow-up was less than 24 months. 2 patients died during the follow-up period and were divided into a separate cohort.

Results: The average age was 10 years, 7 months (range, 0 years, 9 months to 20 years, 0 months). The mean followup was 40 months (range, 24-70 months). Cancer status was determined at most recent encounter with the patient and/or caretaker(s). There were no cases of new malignancy, or degeneration or metastasis of existing tumors in our small cohort of pediatric patients. Moreover, the definitive cause of death was determined in 2 of our 2 patients that died during the study period; none of the deaths were related to BMP nor the development, degeneration, or metastasis of cancer.

Conclusions: Despite the large number of adult studies reporting positive effects of BMP on cancer, our long-term outcomes using rhBMP-2 in the pediatric population suggest that it is a safe adjunct to posterior spine fusions of the occipitocervical, cervical, thoracic, lumbar, and lumbosacral spine. There were no new cases of cancer, or degeneration or metastasis of existing malignancies in our series of children after 24 months of follow-up.

204. Radial to Axillary Nerve Neurotization for Brachial Plexus Injury in Children: A combined case series and review of the literature

John Wellons, MD, MS; Scott Zuckerman, MD; Ilyas Eli, BS; Manish Shah, MD; Nadine Bradley, RN; Christopher Stutz, MD; Tae Sung Park, MD (Nashville, TN)

Introduction: Axillary nerve palsy, isolated or as part of a more complex brachial plexus injury, can have profound effects on upper extremity function. Radial to axillary nerve neurotization is a useful technique for regaining shoulder abduction with little compromise of other neurologic function. A combined experience of this procedure used in children is reviewed.

Methods: A retrospective review of the authors' experience across 3 tertiary care centers with brachial plexus and peripheral nerve injury in children (less than 18-years-old) revealed 7 cases involving patients with axillary nerve injury as part of an overall brachial plexus injury with persistent shoulder abduction deficits. Two surgical approaches to the region were used.

Results: Four infants (ages: 4, 4, 6, and 6 months) and 3 older children (ages: 8, 15, and 17 years) underwent surgical intervention. No patient had significant shoulder abduction past 15 degrees preoperatively. Three patients had additional neurotization performed in conjunction with the procedure of interest. Two surgical approaches were used: posterior and transaxillary. All patients displayed improvement in shoulder abduction. All were able to move deltoid against gravity and 4/7 were able to abduct against resistance. The median follow up was 15 months (range 8 months to 5.9 years).

Conclusions: Radial to axillary nerve neurotization improved shoulder abduction in our series of patients that spanned 3 institutions. While rarely used in children, this neurotization procedure is an excellent option to restore deltoid function in children with brachial plexus injury due to birth or accidental trauma.

205. Radiographic Accuracy in Assessing Intrathecal Baclofen Catheter Malfunction

Hirad Hedayat, MD; Daniel Couture, MD; Aravind Somasundaram, BS (Winston Salem, NC)

Introduction: Intrathecal Baclofen (ITB) is an effective treatment for severe spasticity with a 25-44% overall complication rate and 5-15% rate related to the intrathecal catheter. Radiologic assessment is a crucial tool in identifying a malfunction cause and necessity for revision. We review our experience with radiographic assessment in the setting of potential catheter malfunction and its utility in determining the need for revision.

Methods: 64 ITB system revisions were performed between September 2008 and August 2012. A retrospective review determined the rate of planned and unplanned revisions with attention to preoperative radiographic studies.

Results: 54 patients underwent 64 procedures. 42 of 64 revisions (65.63%) were performed without suspicion for catheter malfunction though 9 (21.43%) revealed an intraoperative catheter malfunction. In 21 instances of suspected catheter malfunctions all patients received preoperative imaging with 9 (40.9%) indicating an abnormality. Plain film radiography was the standard study acquired with additional imaging obtained selectively. One CT demonstrated catheter discontinuity thereby rendering 100% accuracy in identifying a catheter complication. 3 fluoroscopic ITB studies were performed (1 demonstrating no intrathecal flow, 2 normal) with an accuracy of 33.3% in identifying a real-time ITB system malfunction.

Conclusions: Imaging remains a key component in the evaluation of a suspected ITB system malfunction. In our series, 59.1% of patients with a mechanical complication demonstrated no preoperative radiographic abnormalities suggesting that a patient with ongoing symptoms and normal imaging studies warrants surgical exploration and potential empiric catheter replacement. CT may be of benefit but would not likely change the need for catheter revision.

206. Rare Occurrence of a Spontaneous Subarachnoid Hemorrhage in an Infant: A Case Report of Basilar Tip Aneurysmal Rupture .

Zulma Sarah Tovar-Spinoza, MD; Venita Simpson, MD; Eric Deshaies, MD; Amar Swarnkar, MD (Syracuse, NY)

Introduction: Intracranial Aneurysms are rare in childhood accounting for 0.5%-4.6% in patients 0-18 years of age; they are infrequent in infants accounting for 0.1%. Intracranial aneurysms in children differ from those in adults in relation to sex predilection, location, morphology, size, multiplicity, etiology, rate of spontaneous aneurysm thrombosis, susceptibility to post hemorrhagic vasospasm with or without delayed ischemic neurologic deficits, and management. We present a rare case of an infant with subarachnoid hemorrhage secondary to basilar tip aneurysm rupture and a review and the most recent literature.

Case Report: A previous healthy full term 7-month-old female presented to the emergency department with sudden neurological deterioration and seizures. There was no family history of vascular disease, trauma, or infection. CT head revealed diffuse subarachnoid hemorrhage along the sylvian fissures and basal cisterns with intraventricular extension and hydrocephalus. MRI/MRA revealed extensive bilateral cortical infarct and swelling within the parieto-occipital region and a 2mm basilar tip aneurysm. The patient had a right frontal EVD placed emergently and underwent diagnostic cerebral angiogram and a two-step coiling of her basilar tip aneurysm. Management consisted of normotensive, normovolemic status and intracranial pressure monitoring.

Conclusion: Aneurysms in infants are rare; therefore specific treatment protocols for this population do not exist. Most aneurysms in patients

207. Rare Occurrence of a Spontaneous Subarachnoid Hemorrhage in an Infant: A Case Report of Basilar Tip Aneurysmal Rupture and Review of the Literature

Venita Simpson, MD; Zulma Tovar-Spinoza, MD (Syracuse, NY)

Rare Occurrence of a Spontaneous Subarachnoid Hemorrhage in an Infant: A Case Report of Basilar Tip Aneurysmal Rupture and Review of the Literature

Simpson, V, Swarnkar, A. Deshaies, E., Tovar-Spinoza, Z.

Introduction: Intracranial Aneurysms are rare in childhood accounting for 0.5%-4.6% in patients 0-18 years of age, and even more infrequent in infants accounting for 0.1%. Intracranial aneurysms in children differ from those in adults in relation to sex predilection, location, morphology, size, multiplicity, etiology, rate of spontaneous aneurysm thrombosis, susceptibility to post hemorrhagic vasospasm with our without delayed ischemic neurologic deficits, and management. We present a rare case of an infant with subarachnoid hemorrhage secondary to basilar tip aneurysm rupture and a review and the most recent literature.

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Conclusion: Aneurysms in infants are rare; therefore specific treatment protocols for this population do not exist. Most aneurysms in patients <1 year old are located in the MCA (42%) and in the posterior circulation (24%). The cause of these aneurysms is unclear and further studies and reports are needed.

208. Withdrawn

209. Reducing the anxiety levels of Parents during operations on their child: Are periodic telephonic updates helpful?

Adarsh Nadig; Ian Kamaly-Asl (Salford, United Kingdom)

Introduction: We wished to assess the benefit of undertaking regular telephonic updates during long procedures using a novel technology to our department.

Methods: A digitally enhanced cordless telecommunications (DECT phone £312) was given to the parent at the start and periodic updates were given at various stages of the procedure.

Results: There were 18 families who were given telephone updates and surveyed. The mean number of updates received by family were of 4.8 (range 1 to 9). On a visual analogue scale where 0 was not at all anxious and 10 was the most anxious I have ever been, the mean anxiety levels at the start of the operation were 8.8. The mean score for reduction of anxiety with the updates was 9.4 on a visual analogue scale where 0 was did not make a difference to 10 strongly agree, it reduced. There was a significant correlation between the number of updates and the score for the reduction in anxiety (correlation coefficient 0.66, p In a smaller group of 6 families who did not receive telephone updates, the anxiety levels at the start of the operation were 7.6 (not statistically different to the telephone update group - TTest P=0.25). At the end of the operation however the mean anxiety level on the same visual analogue scale had risen to 8.0.

Conclusions: Telephonic updates clearly reduce the anxiety of parents during operations on their child.

210. Relationship of Pediatric Glioblastoma to the Subventricular Zone Predicts Survival

Frank Joseph Attenello III, MD; Eisha Christian, MD; Tong Yang, MD; Rupal Parikh, BS; Stephanie Da Silva, BA; Floyd Gilles, MD; Jonathan Finlay, MD; J. Gordon McComb, MD; Mark Krieger, MD (Los Angeles, CA)

Introduction: Multiple prior studies suggest decreased survival among adult patients with glioblastoma multiforme (GBM) adjacent to the lateral ventricles. The subventricular zone (SVZ), the cellular region lining the lateral ventricles, represents neural stem cell origin and potential tumor stem cell origin. This is the first pediatric study to evaluate survival among a population with GBM adjacent to the lateral ventricles.

Methods: Retrospective analysis was performed on all children with available preoperative magnetic resonance imaging treated at a single institution from 2000 to 2013 with biopsy proven GBM. Tumor was evaluated by volume and contact with the lateral ventricle on preop imaging. Overall survival was evaluated via cox regression as a function of contact with the lateral ventricle.

Results: 15 children (12+5 years) were identified with available preoperative imaging. Median duration of followup was 11.1+6.3 months. 6 (38%) patients exhibited tumors adjacent to the lateral ventricle. When adjusting in multivariate analysis for age, gender, extent of resection, repeat resection, and tumor volume, proximity to the SVZ remained independently associated with decreased survival ($p<0.05$).

Conclusions: Tumor location in a pediatric GBM population may hold relative prognostic significance. Further study is warranted to evaluate causative factors associated with survival among pediatric GBM adjacent to SVZ .

211. Reliability of Marshall CT score in Pediatric Patients with suspected Traumatic Brain Injury

Amber Shea Gordon, MD; Bonitta Agee, PhD; Elias Rizk, MD; Curtis Rozzelle, MD; James Johnston, MD (Birmingham, AL)

Introduction: Traumatic brain injury (TBI) is the leading cause of disability and death in children and adolescents in the U.S. In 1991, Marshall proposed a novel classification system for patients with TBI. This scoring system identifies six different groups of patients with TBI based on abnormalities seen on CT scans. Though widely used, the inter-rater reliability of the Marshall CT scoring system has never been evaluated in the pediatric population.

Methods: The Children's of Alabama Trauma Registry identifies all trauma patients admitted to our center. From this registry, we randomly identified 50 patients with a diagnosis of TBI admitted between February 2004 and July 2008. Penetrating head trauma was excluded from this study. Imaging data obtained as part of standard clinical care at Children's of Alabama were retrospectively reviewed with the approval of the institutional review board. Fifteen patients were excluded due to incomplete imaging records. The initial non-contrasted CT of the brain was assessed independently by 4 raters (one senior resident, one fellow, two attending neurosurgeons). Statistical analysis was performed using SAS statistical software version 9.3. Interobserver agreement was determined using intra-class correlation coefficient (ICC) and Kendall's rank correlation coefficient.

Results: An overall agreement of 77% was found between the 4 raters. 27 out of 35 patients had 100% agreement. The inter-rater reliability was substantial with an ICC of 0.821 (95% CI: 0.726, 0.895) and Kendall coefficients ranging from 0.836 to 0.963.

Conclusions: The Marshall classification system is a reliable means to assess CT imaging in pediatric patients with suspected TBI.

212. Withdrawn

213. Retrospective comparison of CT and MRI in acute pediatric head injury

Steven W. Hwang, MD; Megan Sweeney; Marie Roguski; Jordan Talan; Leslie Rideout; Ron Riesenburger (Boston, MA)

Introduction: Increasing attention has been focused on the potential harmful effects of radiation from CT imaging in children. However, MRI use in head injury has largely been limited to prognostic evaluation in a subacute fashion and non-traumatic injury assessment.

Methods: We retrospectively reviewed the pediatric trauma database of a level 1 trauma center over the last 10 years to identify pediatric patients (<18 years of age) with a head CT and MRI within 5 days of each other.

Results: Of 574 pediatric patients who were admitted with a head CT, 35 had an MRI within 5 days of the CT. The mean interval between imaging was 1 day with 63% being male. The mean age was 8.5 ± 6.5 years. The mean injury severity score was 13 ± 10 and a mean GCS of 9 ± 6. Of the 70 imaging studies, 105 abnormal findings were reported. MRI studies did not identify 9 findings and CT missed abnormalities in 12 patients (16 findings). All MRI missed findings were non-depressed skull fractures whereas CT did not identify diffuse axonal injury (N=7), subarachnoid hemorrhage (N=1), small subdural hemorrhages (N=5), an encephalocele, and 2 contusions.

Conclusions: As would be expected, MRI studies were less reliable in identifying osseous injuries and more dependable in the diagnosis of other injuries including small hemorrhages. In select patients, an MRI may be a viable option in the assessment of pediatric head injury, if a quick and efficient protocol can be implemented.

214. SMARCE1 Mutations in Pediatric Clear Cell Meningioma: A Review and Case Illustration

Linton T. Evans, MD; David Bauer, MD; Jack Van Hoff, MD (Lebanon, NH)

Introduction: Clear cell meningioma(CCM) is an uncommon histologic variant of meningioma. These tumors tend to affect pediatric patients favoring the lumbar spine. Despite benign histologic features CCM exhibit aggressive behavior with a 60% recurrence rate. Recently a heterozygous loss-of-function mutation in SMARCE1 was found in four individuals with familial multiple spinal meningiomas. We report the only other case of SMARCE1 mutation in a 3 year-old with intrapsinal CCM.

Methods: Case report

Results: A three-year-old male presented with six-weeks of knee pain, urinary incontinence and refusal to walk secondary to pain. Strength and sensation were normal but his left patellar DTR was decreased. MRI of the spine revealed a T1- and T2-isointense mass measuring 3x1.5cm with homogenous enhancement. The lesion was intradural-extramedullary with compression of the nerve roots. Gross-total resection was performed and histologic diagnosis was CCM. He was neurologically intact with no recurrence on MRI at three-months. Exome sequencing of circulating lymphocyte DNA revealed a heterozygous mutation in exon 6 of the SMARCE1 gene. Tumor cells exhibited loss of heterozygocity with loss of the second allele. His maternal uncle had two spine tumors removed at age 21 with unknown pathology and is awaiting genetic testing.

Conclusions: We report a case of spinal CCM in a child with mutation in the SWI/SNF chromatin remodeling complex subunit SMARCE1. Mutations in SMARCE1 are found in other clear cell tumors and non-NF2 familial meningiomas. The role of SMARCE1 in CCM development has not been defined but represents a potentially novel mechanism in tumor formation and target for treatment.

215. Sellar Pathology and Chiari I Malformations

Todd A. Maugans, MD; Todd Maugans, MD (Orlando, FL)

Introduction: Pediatric Chiari I malformation (CIM) typically occurs as an isolated pathology. Possible causitive factors, including growth hormone (GH) deficiency, have been associated with the develoment of CIM. Sellar lesions affecting pituitary and hypothalmic function may lower GH production and/or secretion. Cases that demonstate the dual pathologies of sellar mass and CIM would strenghten the thesis that GH plays a causative role in development of CIM.

Methods: The authors report two patients who presented with sellar lesions and CIM. A systematic literature review was performed to ellucidate the possible relationship of these dual pathologies.

Results: Patient 1 presented in early infancy with failure to thrive and was discovered to harbor bilateral retinoblastoma and suprasellar primitive neuroectodermal tumors. He had GH deficiency and showed progressive development of an asymptomatic CIM. This stabilzed after GH replacement and did not require surgical intervention. Patient 2 presented with symptomatic CIM and underwent an ultrasound-guided decompression at age 3 years. Shortly thereafter, a pre-existing, small, benign-appearing cystic sellar lesion began significant enlargement and was partially resected; the lesion was a cranipharngioma and the small residual showed rapid growth, necessitaing proton beam therapy. GH defiicency was diagnosed but not treated. The patient required a second CIM decompression following development of a cervical syrinx.

Conclusions: These cases suggest that the development of early life CIM is related to GH deficiency caused by congenital sellar lesions.

216. Single specialty laparoscopic approach in pediatric ventriculoperitoneal shunt placement: operative technique

Tanya Minasian, DO; Daniel Won, MD (Redlands, CA)

Introduction: This technical note illustrates the feasibility of a single specialty laparascopic approach in pediatric ventriculoperitoneal shunt surgery utilizing a single incision without insufflation.

Methods: Operative technique will demonstrate successful and safe outcome in the laparascopic approach, as performed at a single institution by a pediatric neurosurgeon, without the assistance of a general surgeon. For distal catheter placement, a single periumbilical incision is made. Utilizing a Veress needle and optical trocar, entry into the peritoneal cavity is completed safely under endoscopic visual guidance, without requiring the use of insufflation. Once proper anatomy is confirmed, the catheter is fed through a peel away sheath.

Results: All patients tolerate the procedure well and have successful placement of peritoneal catheters. Direct visualization using the optical trocar increases safety, while retaining the pediatric neurosurgeon's independence to operate without assistance from another specialty

Conclusions: Results of comparative studies between laparascopic versus open peritoneal catheter insertion in shunt surgery have been described, with evidence in favor of the former. Decreased time in the operating room and hospital stay, and more importantly, fewer distal shunt obstructions have been shown in the adult literature. Similarly, single incision laparascopic catheter placement is being discussed more in the pediatric literature with comparable results. Laparosopic shunt surgery is the favored surgical technique as compared to traditional shunt surgery given these multiple advantages. Enhancing the laparosopic approach by adding the element of independence and increased safety with the abovementioned technique, can further advance the field of pediatric shunt surgery by leading to better outcomes overall.

217. Sinus Pericranii: An Overview and Case Series

Eric J. Arias, MD; Manish Shah, MD; Matthew Smyth, MD (St Louis, MO)

Introduction: Sinus pericranii is a rare anomaly that consists of atypical connections between the intracranial and extracranial venous systems. It usually presents in children, and is classically described as a palpable, soft scalp mass that enlarges with increases in intracranial pressure. Sinus pericranii can be associated with other lesions, and usually occur in the midline. Lesions are usually removed surgically for cosmetic reasons or concern for traumatic injury. We report our institution's experience with this rare lesion.

Methods: A retrospective chart review from January 1998 to July 2013 identified all patients with sinus pericranii. Their hospital records and pertinent medical imaging were analyzed, and clinical characteristics, imaging findings, and follow-up were recorded.

Results: A total of eight patients (six male, two female) were identified. All underwent surgical excision of their lesion. The average age at presentation and treatment were 21 months and 26.5 months, respectively. All presented for cosmetic reasons. Three had overlying angiomas and one had an adjacent atretic cephalocele and hydrocephalus. All but one exhibited enlargement in the recumbent position, and only two were pulsatile. Locations included five in the midline parietal area, one paramedial parietal, one right frontal, and one left frontal along the coronal suture. Four had identifiable bony defects on imaging, and 5/6 that received contrast displayed enhancement. No postoperative complications were noted, with follow-up ranging from 17 days to 13 months.

Conclusions: Our experience correlates with prior reports, and demonstrates that sinus pericranii are rare lesions that can be surgically removed with little complication.

E-POSTER ABSTRACTS

218. Skin markers of occult spinal dysraphism in children

Sima Sayyahmelli, MD; rakhshandeh alipanahi, MD (Tabriz, Iran (Islamic Republic of))

Introduction: Background Occult spinal dysraphism represents a spectrum of congenital anomalies that is characterized by skin-covered lesions without exposed neural tissue can cause rostrocaudal traction on the spinal cord. Prophylactic surgery has a high likelihood of changing the natural history in which a gradual loss of function may be replaced by clinical stability. Detection of OSD in infants is difficult because an abnormal neurological examination is often not apparent until the child becomes ambulatory, or even later. Cutaneous signs are often the initial marker of congenital spine abnormalities and investigation of skin lesions in these patients may cause earlier diagnosis of OSD.

Methods: prospective study of 41 patients referred to the Department of neurosurgery between 2007 and 2011 for congenital midline lumbosacral cutaneous lesions.

Results: 41 patients in the age range of 4months to 13 years were included in this study. there were 38.5%male.Skin stigmata were present in 66.66% of patients Most frequent findings were hypertrichosis and then lipoma.

Conclusions: The discovery of a midline skin lesion in an otherwise well, asymptomatic neonate or child often prompts a search for OSD using imaging modalities.Cutaneous markers in a high percentage accompany spinal malformations. They can aid the clinician in further diagnostic and therapeutic work. The knowledge of these skin lesions can guide the clinician to underlying spinal pathology.

219. Slit Ventricle Syndrome: Conservative vs. Surgical Management

Shawnelle Contini, Physician Assistant; Robert Physician Assistant; Grace Rochford, RN; Mark Luciano, MD, PhD (Cleveland, OH)

Introduction: Slit ventricle syndrome is one of the most common and difficult complications of hydrocephalus treatment. It arises from the difficulty in draining CSF at the appropriate physiological level and results in shunt failures, multiple shunt revisions, patient morbidity and mortality. Treatments for this syndrome vary, and no definitive treatment has been established.

Methods: This retrospective chart review encompasses shunted hydrocephalus who developed slit ventricle syndrome and underwent four or more neurosurgical evaluations over the past decade. The following data was extracted: (1) Age shunted (2) Age presented with slit ventricle syndrome (3) Symptomatic/ Asymptomatic (4) Radiographic results (5) Treatment (6) Outcome. Patients were then categorized as either nonsurgical or surgical. More than 310 patients were identified with only forty eight developing the syndrome. Success was identified as improvement in ventricular size and/or symptoms.

Results: Comparisons were made on success, symptoms, resolution, and age. In the surgical group, 15 patients (58%) had success, as compared to 13 (59%) in the non-surgical group. The mean age of shunt placement was 6 years among non-surgical patients and 10 years among surgical patients, but the difference was not statistically significant. Patients in the surgical group were significantly more likely to have all of the symptoms, except headache, as compared to non-surgical patients.

Conclusions: Management of slit ventricle syndrome has been ineffective with both nonsurgical and surgical interventions. Despite these findings, clinicians tend to utilize surgical interventions more in the presence of a multitude of symptoms and should continue to utilize their clinical judgment in cases with this diagnosis.

220. Socioeconomics and Inpatient Outcomes of Intraventricular Hemorrhage in a National Sample of Premature Infants

Edward Ahn, MD; April N. Sharp (Baltimore, MD)

Introduction: Complications of intraventricular hemorrhage (IVH) in premature infants routinely require neurosurgical intervention and long-term care. This study aims to provide national estimates of the socioeconomic profile and inpatient burden of IVH.

Methods: We selected infants within 90 days of birth from the 2006 Kids' Inpatient Database, a HCUP database containing a national sample of pediatric discharges. Using ICD-9 codes, we identified infants diagnosed with prematurity ≤30 weeks, IVH, and who required neurosurgical intervention. Multivariate analysis was performed on demographics and inpatient data to identify disparities and predictors of length of stay (LOS), total charges, and mortality.

Results: Premature infants were more likely non-white (OR 1.27, $p<0.001$), below median household income (OR 1.09, $p=0.02$), and holding public or no insurance (OR 1.16, $p<0.001$) with no differences based on IVH diagnosis. OR of being female with IVH was decreased (0.87, $p=0.001$). Mean LOS increased from 3.2 days in non-premature infants to 34.0 in premature without IVH, 53.1 with IVH, and 77.2 when neurosurgery was performed (p-values<0.0006). Mean total charges similarly increased from $7,892 to $148,991, $248,368, and $358,764, respectively (p-values<0.0006). Females with IVH had decreased inpatient mortality (OR 0.68, $p=0.001$). Grade III and IV IVH demonstrated increased mortality (OR 3.49, $p<0.001$ and 13.54, $p<0.001$, respectively) compared to Grade I. Socioeconomic factors did not significantly affect mortality.

Conclusions: Nationally, socioeconomic disparities associated with prematurity underlie disparities in IVH incidence. Targeting prevention of prematurity in these populations will lessen the inpatient demand placed on hospitals and the neurosurgical workforce by infants with IVH.

221. Soft Tissue Defects after Spinal Instrumentation in 5 Children: Risk Factors, Management Strategies, and Outcomes

Sudhakar Vadivelu, DO; Andrew Livingston, MD; Allen Ho, BS; Shayan Izadoost, MD; Tom Luerssen, MD; Andrew Jea, MD (Houston, TX)

Introduction: Wound-related complications following complex posterior spine procedures in children may result in the need for serial debridements and may place spinal instrumentation at risk. In this study, we review our experience with the management of soft tissue defects from spinal instrumentation in 5 high-risk pediatric patients. We discuss the use of various rotational and transpositional flaps in the management of these complicated cases, and their outcomes.

Methods: Out of a series of 128 consecutive cases where spinal instrumentation was used, we retrospectively reviewed the medical records of 5 patients who returned to the Neuro-Spine service at Texas Children's Hospital for erosion of spinal instrumentation through the skin between September 1, 2007 and October 31, 2012. Patient demographics and clinical and operative data were recorded.

Results: Risk factors such as young age (one case), poor nutritional status (one case), multiple previous surgeries (three cases), severe neurological deficits (two cases), and history of radiation therapy for malignancy (two cases) were seen in our 5 patients. The paraspinous flap (four cases) was the mainstay of our treatment. One of our patients required more than one procedure for revision of the wound. Cultures were positive in 2 of the 5 cases. Spinal instrumentation was removed in 3 of the 5 cases; however, in all 3 of the cases, there was evidence of delayed instability that developed after the removal of spinal instrumentation.

Conclusions: The use of local tissue flaps is safe and efficacious for treatment of posterior wound complications due to spinal instrumentation in children. Removal of spinal instrumentation should be avoided due to the development

of delayed instability. Highly vascularized tissue is used to speed healing, clear bacteria, and eliminate dead space, obviating the need to remove contaminated spinal instrumentation.

222. Soft Tissue Defects after Spinal Instrumentation in 5 Children: Risk Factors, Management Strategies, and Outcomes

Christina Mieko Sayama, MD, MPH; Sudhakar Vadivelu, DO; Andrew Livingston, MD; Allen Ho, BS; Shayan Izadoost, MD; Thomas Luerssen, MD; Andrew Jea, MD (Houston, TX)

Introduction: Wound-related complications following complex posterior spine procedures in children may result in the need for serial debridements and may place spinal instrumentation at risk. We review our experience with the management of soft tissue defects from spinal instrumentation in 5 high-risk pediatric patients. We discuss the use and outcomes of various rotational and transpositional flaps in the management of these complicated cases.

Methods: Out of a series of 128 consecutive spinal instrumentation cases, we retrospectively reviewed the medical records of 5 patients who returned to the Neuro-Spine service at Texas Children's Hospital for erosion of spinal instrumentation through the skin between September 1, 2007 and October 31, 2012. Patient demographics and clinical and operative data were recorded.

Results: Risk factors such as young age (one case), poor nutritional status (one case), multiple previous surgeries (three cases), severe neurological deficits (two cases), and history of radiation therapy for malignancy (two cases) were seen in our 5 patients. The paraspinous flap (four cases) was the mainstay of our treatment. Follow-up ranged from 7.5 to 17.5 months (Mean 11±4.2 months). One of our patients required more than one procedure for revision of the wound. Cultures were positive in 2 of the 5 cases. Spinal instrumentation was removed in 3 of the 5 cases and all 3 of the cases had evidence of delayed instability.

Conclusions: The use of local tissue flaps is safe and efficacious for treatment of posterior wound complications after spinal instrumentation in children. Highly vascularized tissue is used to speed healing, clear bacteria, and eliminate dead space, obviating the need to remove contaminated spinal instrumentation.

223. Supracerebellar Transtentorial approach to resection of posterior medial temporoccipital tumors in children with refractory epilepsy

Sanjiv Bhatia, MD, FAANS, FACS; Andrew Middleton, MD; Toba Niazi, MD; Alexander Weil, MD; John Ragheb, MD (Miami, FL)

Introduction: Tumors arising in the medial occipitotemporal regions are challenging due to their deep-seated location and close relationship to the midbrain and adjacent eloquent temporal and occipital cortex. Surgical access is limited and often requires temporal or occipital retraction, with risk of venous sacrifice or a transcortical approach. We report the use of the supracerebellar transtentorial (SCTT) approach to tumors of the posterior medial occipitotemporal region in children with medically refractory epilepsy .

Methods: We conducted a retrospective review of consecutive patients undergoing the SCTT approach for tumors associated with refractory epilepsy at the Miami Children's Hospital, between 2009 and 2013

Results: All the patients were operated in the lateral park-bench position. The age ranged from 13 months to 16 years. All patients presented with seizure disorder related to a tumor involving the parahippocampal and fusiform gyrus of the left (n=2) or right (n=2) temporal lobe. Gross total resection was achieved in all cases with intraoperative electrocorticography. There were no procedure-related complications. There were no tumor recurrences at mean follow up of 26-months (range 2-48). Epilepsy outcome was excellent with all 4 patients being seizure free

Conclusions: The paramedian SCTT approach represents a viable approach to tumors of this region with minimal morbidity and a satisfactory working corridor. Our experience demonstrates that this approach can be used satisfactorily in children with refractory epilepsy.

224. Surgery for obstructive non-tumoral posterior fossa problems

Carolina Sandoval-Garcia, MD; Mark Kraemer, BS; Bermans Iskandar, MD (Madison, WI)

Introduction: Safe treatment of obstructive, non-tumoral, pathologies in the cerebral aqueduct and fourth ventricle faces serious challenges owing to difficulties in maintaining fourth ventricular shunt patency, predisposition to form complex adhesions, and risk of brainstem injury.

Methods: We present our 15-year experience in treating aqueductal and fourth ventricular obstructions that are unrelated to tumor or vascular pathology, using a multi-modality approach of microsurgical and endoscopic surgery.

Results: 95 surgical interventions were reviewed. Symptoms of bulbar and sensorimotor dysfunction were related to ventricular dilatation in some, and tethering of brainstem/cerebellar tissue in others. Pathologies included membranous and/or focal aqueductal obstruction proven or presumed to be infectious/inflammatory in origin; fourth ventricular entrapment; adhesions from chronic shunting with/without retained ventricular catheters; inability to maintain fourth ventricular shunt patency; and postoperative adhesions after tumor or Chiari surgery. A primary endoscopic approach was used in 42 cases, and microsurgery with or without endoscopic assistance in 53 cases. Clinical and radiographic goals were achieved in <90% of patients with acceptable morbidity. Challenges specific to the posterior fossa and aqueduct including adhesions and the tangible risk of brainstem injury will be described.

Conclusions: Surgery on obstructive posterior fossa and aqueductal lesions is challenging. This is especially true in the setting of complex postoperative adhesions. We describe our long-term experience with these cases using a combination endoscopic/microsurgical approach. Long-term success is likely to be maintained when CSF flow is re-established in the absence of a CSF shunt, thus improving on the typically disappointing natural history of these disorders.

225. Surgical Management of Pediatric Arteriovenous Malformations: Institutional Experience and Impact of a Novel Practice Protocol on Radiographic and Clinical Outcomes

Edward Robert Smith, MD, FAANS; Armide Storey; Bradley Gross; Darren Orbach; R. Michael Scott (Boston, MA)

Introduction: Our single-center experience analyzes presentation, management and outcomes of pediatric AVMs, assessing impact of recent advances in embolization and operative technique. Efficacy of an AVM treatment protocol is evaluated.

Methods: Retrospective review.

Results: 115 pediatric patients (age<21years) with AVMs from 1995-2013 were reviewed. 101 operations were performed on 92 children (42 male/50 female, mean age 11y at first treatment, range 2m-20y). Presentation included: hemorrhage (57%), seizure (13%), headache (14%), asymptomatic (15%). Radiographic evaluation revealed Spetzler-Martin (SM) Grades 1(15%), 2(48%), 3(34%), 4(3%); other findings included aneurysm in 10% and venous stenosis in 6%.Since 2008, a new perioperative protocol has been followed for all cases (n=48), including possible preoperative embolization and mandated perioperative angiography post-resection (results listed as pre- and post- protocol after averages).Operatively, blood loss averaged 185ml (215ml pre-protocol vs. 160ml post). No deaths occurred. Complications included postoperative hemorrhage (6% vs. 0%) and CSF leak (3% vs. 2%). New neurologic deficits occurred in 22% (29% vs. 16%);68% were visual field cuts with only one major disability (1%, hemiplegia, pre-protocol). Higher SM Grade correlated with increased likelihood of post-operative deficits.Outcome analysis with modified Rankin score (mRS) revealed 85% of patients stable-to-improved relative to preoperative baseline at 1 year or longer postoperatively (75% vs. 93%;*p<0.05). Unexpected residual AVM requiring further surgery was reduced by protocol utilization (13% vs. 2%*p<0.05).

Conclusions: AVM surgery has evolved over time, with these data demonstrating improved clinical and radiographic outcomes, specifically with the advent of an institutional protocol that has reduced complications and increased long-term cure rates.

226. Surgical Outcomes in Pediatric Spinal Cord Ependymomas

Nalin Gupta, MD, PhD, FAANS; Michael Safaee, BS; Michael Oh, MD, PhD; Praveen Mummaneni, MD; Philip Weinstein, MD; Christopher Ames, MD; Dean Chou, MD; Mitchel Berger, MD; Christopher Ames, MD; Andrew Parsa, MD, PhD (San Francisco, CA)

Introduction: Ependymomas are among the most common central nervous system (CNS) tumors in children, however less than 15% originate from the spinal cord. Aside from extent of resection, factors affecting outcome are not well understood.

Methods: A single-institution neuropathology database was queried to identify pediatric patients (age < 21 years) with spinal cord ependymomas treated over the past 20 years.

Results: A total of 14 classical (EPN) and 8 myxopapillary (MPE) ependymomas were identified with a mean follow-up time of 63 and 45 months, respectively. The rate of gross total resection (GTR) was 50% for EPN and 86% for MPE. Three recurrences were identified in the EPN group at 45, 48, and 228 months. A single recurrence was identified in the MPE group at 71 months. The mean progression-free survival was 65 months in the EPN group and 53 months in the MPE groups. Although extent of resection is an important prognostic factor, our data suggests that achieving GTR is more difficult in the upper spinal cord, making tumor location another important factor.

Conclusions: Although classified as grade I lesions, MPEs had similar outcomes when compared to EPNs in our study. Their biological behavior may be more aggressive than anticipated. Nevertheless, our data suggest that pediatric spinal cord ependymomas can be safely treated by surgical resection; although the role of adjuvant therapies remains undefined.

227. Surgical Treatment of Congenital Thoracolumbar Spondyloptosis in a 2-Year-Old Child with Vertebral Column Resection and Posterior-Only Circumferential Reconstruction of the Spine Column: Case Report

George Al shamy; Javier Mata, MD; Thomas Luerssen, MD; Andrew Jea, MD (Houston, TX)

Introduction: Spondyloptosis refers to complete dislocation of a vertebral body on another. It frequently involves the L5-S1 level. Because of its rarity, there have been few published reports describing clinical features and surgical outcomes, especially in the pediatric patient population.

Methods/Results: We present the pathologic findings and radiographic studies of a 2-year-old girl who presented to Texas Children's Hospital with a history of progressive spastic paraparesis since birth. Preoperative CT and MRI showed severe spinal cord compression associated with T11-T12 spondyloptosis. The patient underwent a single stage posterior approach for complete resection of the dysplastic vertebral bodies at the apex of the spinal deformity with reconstruction and stabilization of the vertebral column using a titanium expandable cage and pedicle screws. At 6 months followup, the patient remains neurologically stable without any radiographic evidence of instrumentation failure or loss of alignment.

Conclusions: To the best of our knowledge, our case represents the first child with congenital thoracolumbar spondyloptosis treated with this strategy

228. Surveillance of Family History in Children with Neural Tube Defects

Daxa Mahendra Patel, MD; Betsy Hopson; Anastasia Arynchyna; E. Ralee' Bishop; Brandon Rocque, MD, MS; Jeffrey Blount, MD (Birmingham, AL)

Introduction: Although there are widely accepted known risk factors, little data exists on family history of neural tube defects (NTDs). Understanding the role that family history and genetic factors play in development of NTDs will significantly impact future efforts in preventing this disease. Towards this effort, we set forth to determine the prevalence and lineage of family history in our population.

Methods: Patients accompanied by biological mother were interviewed during their annual multi-disciplinary visit to the Spina Bifida Clinic. Each mother answered questions regarding known NTD risk factors and family history of spina bifida (SB) and other nervous system disorders.

Results: 217 patient interviews were conducted. The overall prevalence of family history of NTDs in children with SB was 18% (n=39). Fourteen (6%) of the patients had first-degree relatives with SB and 10 (5%) had second-degree relatives with SB. Family history in the paternal lineage was 7.8% versus 7% maternal. Nineteen (8.8%) had family history of other congenital nervous system disorders. Furthermore, thirteen (6%) had family history of Down syndrome and nine (4.5%) had family history of cerebral palsy.

Conclusions: Family history of neural tube defect was 18% in children with SB without a difference in maternal and paternal lineage. This high prevalence brings genetics and its role in SB to the forefront and underscores the importance of continued surveillance of family history in children with NTD. Because of widespread folate supplementation, family history may be an increasingly important risk factor for this condition.

229. Syrinx and Headache Resolution Correlates with the pB-C2 Line in Pediatric Chiari I Malformation

Travis Ryan Ladner; Michael Dewan; Matthew Day; Chevis Shannon; Luke Tomycz; Noel Tulipan; John Wellons, III (Nashville, TN)

Introduction: The clinical significance of radiographic measurements of the craniocervical junction (CCJ) in Chiari I malformation (CM-I) is not well understood. The authors examine an institutional experience with the pB-C2 line, a measure of ventral canal encroachment, and its relationship with symptomatology and syringomyelia in pediatric CM-I.

Methods: A neuroradiologist retrospectively evaluated pre and post-operative MRI examinations on 80 pediatric CM-I patients undergoing posterior fossa decompression, obtaining pB-C2 line length and documenting syringomyelia. pB-C2 length was divided into Grade 0 (<3 mm) and Grade I (<= 3 mm). Demographic and clinical data were additionally collected.Statistical analysis was performed using t-test for continuous variables and univariate chi-square analysis for categorical variables.

Results: The median pB-C2 length was 3 mm, ranging from 0 to 10 mm. 65% of patients had a Grade I pB-C2. Patients with a Grade I pB-C2 were much more likely to have a syrinx preoperatively (RR 2.364 95% CI: 1.243-4.493, p=0.008) and, when present, greater resolution of syrinx postoperatively (RR 2.386 95% CI: 1.325-4.298, p=0.008). Grade I patients were also more likely to have improvement in headache postoperatively (RR 2.667 95% CI: 1.115-6.377, p=0.025).

Conclusions: Ventral canal encroachment may explain the symptomatology of select CM-I patients. The clinical findings presented suggest that Grade 0 patients are less likely to benefit from decompressive surgery with duraplasty than Grade I patients when syrinx and/or headache are present. These measurements may be useful in counseling patients and should help direct further prospective studies of preoperative radiographic measurements in Chiari I malformation.

230. Syrinx morphology differs by etiology: Implications for distinct pathogenesis

Jennifer Strahle, MD; Brandon Smith, MD; Joseph Kapurch, MD; Anthony Wang, MD; Karin Muraszko, MD; Hugh Garton; Cormac Maher, MD (Ann Arbor, MI)

Introduction: Syrinx morphology according to etiology has not been clearly defined. In addition, the pathogenesis of syringomyelia is incompletely understood with most prior reports describing syrinx formation using a single theory.

Methods: All patients with a syrinx (≥ 3mm in maximal width) were identified from a cohort undergoing brain or cervical spine imaging over an 11-year interval. Syrinxes associated with open spinal dysraphism were excluded. Maximum anterior-posterior syrinx width and level of cranial and caudal extent were examined.

Results: 243 patients with syrinx were identified. 59% (144) were female and 57% (138) had scoliosis. Tonsil position ≥ 5mm below the foramen magnum was the most frequent association (48%), followed by tethered cord (5%), spinal dysraphism (5%) and tumor (5%). 81 (33%) were idiopathic. Syrinxes associated with low tonsil position were wider (7.9 ± 4.1 mm) compared with idiopathic syrinxes (4.1 ± 1.3 mm; $p<0.0001$) and those associated with cord tethering (4.4 ± 1.4 mm; $p<0.01$). Syrinxes associated with low tonsil position were more likely to have their cranial extent in the cervical region (88%) compared to those associated with cord tethering which were more likely to exhibit a cranial extent in the thoracic spine (58%)($p<0.01$).

Conclusion: Syrinx morphology, including width and location, differs according to syrinx etiology. Wider syrinxes occur with low tonsil position, whereas idiopathic syrinxes and those associated with cord tethering are narrow. Spine syrinxes are a result of multiple causes and these causes are associated with definite differences in presentation, location, and morphology.

231. Tethered Cord Syndrome and Chiari type 1 Malformation in Pediatric Patients: the Argument for Detethering as a First-line Surgery

Chad Allan Glenn, MD; Ahmed Cheema, MD; Sam Safavi-Abbasi, MD; Naina Gross, MD; Timothy Mapstone, MD (Oklahoma City, OK)

Introduction: There is controversy regarding cord detethering in patients with clinical features of tethered cord syndrome (TCS) but without the typical anatomic abnormalities. The causality between TCS and Chiari type 1 malformation (CM1) is unclear. The authors report on the management of patients with CM1 and anatomic, radiographic or clinical features of TCS.

Methods: A retrospective review of 170 cord detetherings between 2008 and 2012 was performed. 23 patients with caudal tonsillar displacement who underwent sectioning of the filum terminale (SFT) were identified. Information regarding clinical presentation, surgical procedures, and clinical outcomes was analyzed.

Results: CM1 was found in 17 (81%) patients with a mean tonsillar herniation of 10.0 mm (±5.0 SD, range 5 to 21 mm). Tonsillar ectopia was found in 4 (19.0%) patients. Patients with a fatty or thickened filum terminale demonstrated greater tonsillar displacement ($P < .005$). A low conus medullaris (CMD) was found in 12 (52.5%) patients. Patients with a normal CMD demonstrated greater tonsillar displacement ($P = .05$). Post-surgical MRI revealed unchanged tonsillar position in all but one case. Symptoms were improved or stable in nearly all cases. 1 patient required Chiari decompression after detethering.

Conclusions: Pediatric patients found to have both CM1 and TCS experience symptomatic improvement from detethering. Except in overtly symptomatic CM1 patients, detethering should be performed as the procedure has a favorable safety profile, prevents the long term consequences of TCS, and may curtail the need for Chiari decompression.

232. The PITT Protocol for Decreasing Morbidity in High Risk Trans-cranial Frontofacial Advancement (Monobloc) and Le Fort III Facial Advancement

Christopher Michael Bonfield, MD; Matthew Grieves, MD; Mandeep Tamber, MD, PhD; Anand Kumar, MD (Pittsburgh, PA)

Introduction: Frontofacial advancement (monobloc) and Lefort III facial advancement are effective, but high-risk procedures in patients with preexisting hydrocephalus and indwelling shunts. The PITT Protocol (Pericranial flap, Internal distraction with 1 week latency, Intraoperative navigation, Temporalis onlay patch, Tissue sealant) was implemented to minimize cerebrospinal fluid (CSF) leaks, prevent meningitis and shunt infections, and ensure safe gradual expansion of the midface and/or cranium.

Methods: A 21-month retrospective cohort study comparing CSF leak rate, meningitis rate, shunt infection and revision rate, and overall infection rate after frontofacial or Lefort III osteotomies in patients with existing shunts placed for hydrocephalus (Group 1) and a control group of patients without CSF shunts (Group 2) was performed.

Results: In Group 1 (n=4) and in Group 2 (n=5), patients were identified who were treated for symptomatic midface hypoplasia by frontofacial or Lefort III osteotomies. Median age was 11.1 years in Group 1 and 12.5 years in Group 2 ($p=0.73$). Median clinical follow-up for Group 1 and 2 were 330.5 days and 140.9 days, respectively ($p=0.19$). No mortality, CSF leaks, meningitis, shunt revisions, or shunt removals occurred in either group. One revision of the cantilever bone graft was required in Group 1. In Group 2, cerebral salt wasting and seizures occurred in one patient, and another had a superficial wound infection.

Conclusions: The PITT protocol is effective when used in high-risk patients with and without preexisting CSF shunts. CSF related infectious complications were avoided. Existing shunts did not require removal or repositioning. There were no CSF leaks.

233. The Use of Preoperative MR Sequences in Evaluating Pre-pontine Cistern Anatomy for Prognosticating ETV+CPC Success in Infantile Hydrocephalus

Luigi Bassani, MD; Jay Riva-Cambrin, MD (Salt Lake City, UT)

Introduction: Endoscopic third ventriculostomy with choroid plexus coagulation (ETV+CPC) is a successful alternative treatment for infantile hydrocephalus. Fenestration of all pre-pontine cistern membranes is thought to be crucial for success. The goal of this study was to determine which MR sequence best quantified these membranes preo-peratively for surgical planning.

Methods: We prospectively evaluated newly diagnosed hydrocephalic infants (age < 2 years) from June 2012 to July 2013 with pre-operative MR imaging and detailed intra-operative videos. The outcomes of interest were the number of pre-pontine cistern membranes, pre-pontine cistern size, third ventricular floor length, and floor thickness documented intra-operatively by the endoscopic video. These were compared to their respective counterparts abstracted from the pre-operative MR sagittal T1, T2 and FIESTA sequences. Intra-operative endoscopic outcomes were blinded to and independently evaluated from MR sequence outcomes.

Results: 8 patients were enrolled. We did not find a significant correlation between the number of pre-pontine cistern membranes on either the T1, T2 or FIESTA sequences and those seen intra-operatively; although the FIESTA sequence subjectively seemed the most predictive of pre-pontine cistern anatomy. We found an association between larger pre-pontine cistern size and the higher number of pre-pontine membranes ($p = 0.04$). Larger pre-pontine cistern size seen on T1, T2, and FIESTA MR sagittal sequences ($p = 0.04$) and via endoscopic intra-operative observation ($p = 0.01$) was associated with ETV+CPC failure.

Conclusion: Measurements of the pre-pontine cistern size may help prognosticate ETV+CPC success. No sequence appears more predictive in identifying pre-pontine membranes.

E-POSTER ABSTRACTS

234. The Value of Placing External Ventricular Drains after Endoscopic Third ventriculostomy

Bermans Iskandar, MD; Thomas Anthony Cassini; Feda Makkiyah, MD; Brandon Rocque, MD (Madison, WI)

Introduction: Efforts to improve care after endoscopic third ventriculostomy (ETV) include decreasing the rate of emergent returns to the hospital for shunt placement, as this may result in life-threatening complications. In this study, we ask whether placing post-ETV external ventricular drains (EVD) to monitor ICP is effective in identifying ETV failure and reducing readmission rates.

Methods: We completed a chart review of 170 ETVs performed between 1997-2010, and examined the detailed records of those patients who had post-operative EVDs. ETV failure was defined as the need for a shunt or repeat ETV. Failure and discharge dates were evaluated to determine whether the failure was identified by ICP monitoring or symptomatic readmission (or rarely death). Success rates sorted by age, etiology of hydrocephalus, and ETVSS were compared to the established literature.

Results: 117 patients underwent ETV with EVD placement for ICP monitoring. ETV success rates and ETVSS were comparable to those in the literature, with a mean follow-up of 4 years (range 3-16yrs). The overall success rate was 53.8%, including congenital aqueductal stenosis (68%), posthemorrhagic hydrocephalus (41%), congenital hydrocephalus of other etiologies (45%), and others. The overall ETV failure rate was 46.2%, with a rate of readmission of 19.6%, compared to an average failure or readmission rate in the literature exceeding 50%, and as high as 68%.

Conclusion: Post-ETV ICP monitoring reduces the readmission rate (46.2% vs. 19.6%) with no decrease in long-term ETV success compared to the literature. This may diminish the risk of life-threatening complications. Prospective studies are needed to confirm these results.

235. Withdrawn

236. Thoracic Epidural Teratoma Causing Spasticity and Failure to Ambulate: A Case Report

Jennifer L Quon; Ryan Grant, MD, MS; Nduka Amankulor, MD; Ernest Wright, MD; Eylem Ocal, MD; Anita Huttner, MD; Charles Duncan, MD (New Haven, CT)

Introduction: Spinal teratomas comprise a rare subset of spinal cord tumors, and here, we describe an even rarer childhood thoracic extradural-intracanalicular teratoma. In general, when children less than 2 years of age fail to achieve age-appropriate gross motor developmental milestones, clinicians focus their differential diagnosis on etiologies ranging from neurological dysfunction to musculoskeletal dysfunction. A review of the clinical presentation, management, and pathophysiology of these tumors aids in promoting recognition and guiding treatment of these lesions.

Methods: We report the case of a 21-month-old boy who presented with marked spasticity, as well as failure to ambulate and meet motor milestones.

Results: An MRI of the spine revealed a large dorsal epidural tumor extending from T3 to T10 with heterogeneous contrast enhancement and severe spinal cord compression. The tumor was resected via thoracic laminectomies, revealing a cystic mass with tissue resembling hair, muscle, and cartilage, with pathology confirming a teratoma. Gross total resection was achieved, and the child eventually gained ambulatory function.

Conclusions: Given that spinal teratomas are rare entities that can present with significant neurologic compromise, they must remain on clinicians' differentials. In particular, when spasticity is present, the differential refines to upper motor neuron dysfunction, which includes this relatively rare childhood spinal tumor. Unfortunately, the exact origin of these tumors remains inconclusive and requires further investigation.

237. Time to First Shunt Failure in Pediatric Patients Over 1 Year Old: A 10 Year Retrospective Study

Chevis Shannon, MBA, MPH, DrPH; Kevin Carr, MD; Ato Wallace, MD; Luke Tomycz, MD; Chevis Shannon, MBA; John Wellons, MD, MPH; Noel Tulipan, MD (Nashville, TN)

Introduction: Young age predicts shunt failure. Additionally, children with IVH of prematurity and spina bifida are typically shunted in the first year of life. We specifically examine co-variables in a 10 year patient cohort over 1 year of age as it relates to hydrocephalus and shunt failure.

Methods: 95 patients were identified between 2000 and 2010 who met inclusion criteria and who had at least 2 years of adequate follow up. IRB approval was obtained for a retrospective review of the EMR. Shunt failure was evaluated using Kaplan Meier survival analysis. Statistical significance was determined a priori at $p<0.05$.

Results: 95 patients were identified between 2000 and 2010 who met inclusion criteria and who had at least 2 years of adequate follow up. IRB approval was obtained for a retrospective review of the EMR. Shunt failure was evaluated using Kaplan Meier survival analysis. Statistical significance was determined a priori at $p<0.05$.

Conclusions: We showed a lower than expected two-year shunt failure rate in older children which might suggest that patients shunted after 1 year of age may require less surgical intervention over time. In addition, congenital hydrocephalus, trauma, and post-craniotomy acquired hydrocephalus accounted for the majority of patients.

238. Top and Bottom Midline Posterior Fossa Arachnoid Cyst Fenestration:How to Avoid Shunting

Eric R. Trumble, MD, FAANS; Alexander Trumble; Matt Diehl (Orlando, FL)

Introduction: Midline Posterior Fossa arachnoid cysts occur in up to 1% of the pediatric population.1 Traditional treatment with shunts(either ventriculo-peritoneal shunt or cysto-peritoneal shunt) are associated with at least a 50% failure rate.6,8 Fenestration has been shown to decrease symptoms and the size of the cysts. 2,3,4 We suggest that midline posterior arachnoid cysts can be safely fenestrated and excised without need of a shunt, consequently reducing complications and need for serial operations. Previously, similar techniques have been shown to work on other sections of the brain (specifically, the middle cranial fossa).5,7 We reviewed our series of craniotomies for posterior fossa cyst fenestration in a pediatric patient population to assess short and long term outcomes.

Methods: From 2004-2012, 11 cases of pediatric patients with symptomatic, midline posterior fossa arachnoid cysts underwent occipital craniotomy for cyst fenestration at the top(supra-cerebellar, infra-tentorial, into the third ventricle) and bottom(communicating with the obex and the upper cervical spine CSF spaces) of the posterior fossa. Consecutive series of charts were reviewed retrospectively, with none lost to follow-up. All were analyzed for appropriate data.

Results: Of the 11 patients, the primary presenting symptom was severe head-aches in 6(55%), hydrocephalus in 3(27%), and ataxia in 2(18%). After we confirmed surgery was needed, patients were admitted to the hospital and underwent an occipital craniotomy for cyst fenestration. Patients were sent to the PICU post-operatively. Cyst fenestration was successful in all patients. 4 patients required a secondary operation(3(27%) required exploration for closure of pseudomeningocele and 1 required a ventriculo-peritoneal shunt). With a mean follow-up of 53 months, no patients have required additional surgery after 6 months of stability. Symptoms improved in all patients.

Conclusions: Top and bottom operation is a safe and effective treatment in pediatric patients with arachnoid cysts and spectrum Dandy Walker variants. The failure rate was acceptably low (92%) and the success rate without complications (62%) was high enough to encourage use of the described procedure.

239. Traumatic Brain Injury as a Cause of Death in Children

Marcia da Silva, MD; Vania de Abreu, MD (Belo Horizonte, Brazil)

Introduction: Trauma is an important cause of death worldwide, especially among children. Head injuries account for a significant portion of these deaths.

Methods: We present a series of pediatric (age below 19 years) trauma patients who died at a large emergency hospital due to a traumatic brain injury (TBI). Data from the databank of the Morbidity & Mortality Committee was analyzed. Patients were included if death occurred in hospital, were under the age of 19 years and whose main diagnosis at the time of admission was a TBI.

Results: There were 4092 deaths due to trauma. From these, 477 patients were under the age of 19. TBI was the main diagnosis on admission for 50% of these patients. Mean age at the time of admission was 12.6 years. Fifty percent of the patients were 15 or older. The majority of patients were boys (82%). Assaults (45.2%) and traffic accidents (41%) were the commonest mechanism of injury. An associated thoracic and / or abdominal injury was diagnosed in 37.6% of patients. Brain swelling and acute subdural hematomas were the most frequent lesions. Ninety percent of the patients presented as a severe TBI (Glasgow coma scale (GCS) score equal to or below 8) on admission and 5.4% as a mild TBI (GCS 13-15).

Conclusions: Head injuries are an important cause of death in all age groups. In our institution, violence and traffic accidents were the main cause of deaths due to TBI.

240. Tuberous Sclerosis Healthcare Utilization Based On The National Inpatient Sample Database: A review of 5655 hospitalizations.

Shaun D. Rodgers, MD; Taylor Wilson, BS; Omar Tanweer, MD; Orrin Devinsky, MD; Howard Weiner, MD; David Harter, MD (New York, NY)

Introduction: Tuberous Sclerosis Complex (TSC) can result from de novo mutations or autosomal dominant inheritance, occurring in 1/6,000 births. Care of these patients is often very complex and costly.

Methods: The National Inpatient Sample (NIS) is a database obtained from the Agency for Healthcare Research and Quality. This database includes approximately 8 millions hospitalizations annually. It represents a stratified sample of 20% of all hospital admissions per year, and is a representative sample of US inpatient admissions. The cohort was reviewed for: demographic, diagnosis, procedures, and relevant outcomes.

Results: Between 2000-2010, the NIS captured 5655 hospitalizations for patients with TSC. The mean age of these patients at time of admission was 22.3 +/- 19.5 years. Slightly more patients were female (52.5% female, 47.5% male) and were white (66.6% white, 14.7 % hispanic, 11.6% black, 7.1% other). The majority patients were admitted to teaching hospitals (71.7%). Over time, the percentage of craniotomies performed per year in TSC patients remained stable ($p = 0.351$), but the use of stereotactic radiosurgical techniques significantly increased ($p = 0.001$). TSC patients with hydrocephalus ($n = 367$) and without hydrocephalus ($n = 5288$) were compared. Hydrocephalus significantly increased the median LOS and total hospital charges for patient. A significantly higher percentage of patients who underwent craniotomy had hydrocephalus (29.8% versus 5.3%; $p < 0.001$), neuro-oncologic pathology (43.5% versus 3.4%; $p < 0.001$), other cranial pathologies (4.2% versus 1.2%; $p < 0.001$), and epilepsy (61.4% versus 40.1%; $p < 0.001$). LOS was 3 days with IQR 2-6 days. The median total charges across all years was $14,807 with an IQR of $7,319-$31,180. The median charges per day of hospitalization was $4,611/day with an IQR of $2787/day-$$7471/day.

Conclusions: The care of TSC patients may be complex and require a multitude of resources. These 5655 hospitalizations may accurately describe the overall care and cost for TSC patients. Further large sample size studies may be needed to capture the overall needs and outcomes of patients with TSC.

241. Withdrawn

242. Urinary Cathepsin-B levels non-invasively predict the presence of pediatric moyamoya

Edward Robert Smith, MD, FAANS; Benjamin Hack; Micah Warf, BA; Katie Pricola, MD; Michael Raber, MD (Boston, MA)

Introduction: Urinary biomarkers provide a non-invasive method to diagnose cerebrovascular disease and tumors. In this study, we present the use of urinary levels of cathepsin-B, an angiogenic cysteine protease, as a novel biomarker capable of detecting the presence of moyamoya.

Methods: Urine was collected from pediatric patients (n=39) with moyamoya (as confirmed by imaging using Japanese national guidelines) and from age- and sex-matched controls following an IRB approved protocol. ELISA was used to quantify the levels of urinary cathepsin-B and the data was normalized to protein concentration using Bradford assays. Results were subjected to univariate and multivariate statistical analysis.

Results: Evaluation of cathepsin-B as a urinary biomarker by ELISA showed statistically significant, clinically relevant elevations in samples from patients with moyamoya as compared to controls.

Conclusion: Cathepsin-B demonstrates potential efficacy as a diagnostic adjunct for pediatric moyamoya. These data support the hypothesis that use of urinary cathepsin-B levels may have utility as a novel, noninvasive method to identify the presence of moyamoya in children.

243. Use of Image-Guided Cerebrospinal Fluid Shunt Placement in Children

Daniel James Guillaume, MD, FAANS; Andrew Xue; Ciro Vasquez, MD (Minneapolis, MN)

Introduction: We compared the accuracy of ventricular catheter placement and shunt survival between catheters placed using standard free-hand technique to those placed using image guidance: ultrasound in infants whose anterior fontanelle, was open, and electromagnetic (EM) navigation in those whose fontanelle was closed. We hypothesized that shunts placed using image-guidance would survive longer than those placed without imagine-guidance.

Methods: This retrospective study included all patients undergoing shunt surgery between February 2012 and April 2013. Post-operative MR or CT images were graded for accuracy of shunt placement: Grade 1 = catheter tip in CSF equidistant from ventricular walls; Grade 2 = catheter tip touching ventricle wall or choroid; Grade 3 = part of catheter tip penetrating brain tissue. Shunt survival was calculated in days from the time of placement until the time of revision.

Results: Sixty-five shunt surgeries were performed: 21 using standard technique, 30 using ultrasound and 14 with EM-guidance. Within the failure groups, on average it took 25 days for standard shunts to fail, 57 days for ultrasound shunts, and 62 days for EM navigated shunts. The mean time to failure for Grade 1 shunts in the failure group was 60 days, 42 days for Grade 2, and 21 days for Grade 3.

Conclusions: This study suggests that image guidance in shunt procedures can improve shunt survival. However, this study did not support the notion that image guidance will lead to lower rates of failure. There are several limitations of this retrospective study.

244. Use of a hybrid lateral mass screw- sublaminar wire construct in pediatric cervical spine stabilization

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Introduction: Pediatric cervical spine stabilization represents a challenge due to fragile bony elements and a paucity of instrumentation available. Hybrid fixation systems are required. We report on an improvised sub-axial cervical spine fixation technique after an instrumentation related lateral mass fracture breakout of a cervical lateral mass screw during placement.

Methods: A 4 year-old with multiple cervical spine injuries including C1-2 subluxation with a severe SCI and bilateral C5-6 perched facets treated initially with external bracing. Follow up imaging showed focal kyphosis at the C5-6 with bilateral facet disruption.During the posterior cervical stabilization lateral mass screws were placed at C5 and right C6 lateral masses with good bony purchase. Lateral breakout of the left C6 lateral mass occurred. In order to ensure a bilateral stable fixation, a sublaminar wire was passed under the C6 lamina and secured to the right C5 lateral mass screw by overlaying the wire and securing it with a locking cap. The sublaminar wire was torqued to compress across the C5-6 joint space. The right C5-C6 lateral mass screws were connected with a standard rod construct.

Results: CT demonstrated reduction of the perched facets. Follow-up, x-rays showed stable alignment and bony fusion across C5-6 posterior elements, with stable alignment in both flexion and extension.

Conclusions: We describe a hybrid fixation technique utilizing with a lateral mass screw-sublaminar wire construct. The technique has not been described prior and proved to be a stable and rigid construct.

245. Use of cranial distractors when treating older children with rickets and craniosynostosis

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Introduction: Although the prevalence of rickets dramatically declined with the discovery of vitamin D, its incidence has again increased in the US. Craniosynostosis has a known association with rickets, being reported in up to 33% of rickets patients.Due to abnormal bone development and a tendency to present at an older age than most craniosynostosis patients, early postoperative skull fusion and inadequate cranial expansion are more likely than in simple cases. We present two children with rickets treated with distraction osteogenesis to demonstrate the effectiveness of this technique.

Methods: Two 3-year-old boys with rickets presented with significant sagittal synostosis. Skull osteotomies were performed with placement of external distractors. The distractors were activated daily over a thirty day period to achieve a target 30mm transverse cranial expansion. A subsequent period of ten to twelve weeks allowed for bone consolidation prior to distractor removal. At this time, we assessed intraoperatively the final distraction distance and the quality of osteogenesis. Postoperative head shape was assessed by parents and surgical teams.

Results: Both children had significant improvement in their head contours by parent and physician assessment. Distraction distances were verified at 30mm. Bone bridging covered the distraction gaps without any palpable areas of incomplete osteogenesis. Estimated blood loss in both cases was 1000ml. Operative times were 262 and 347 minutes. One patient remained intubated until postoperative day four due to volume overload and airway edema, but had no long-term sequelae. The other developed granulation tissue around a distractor exit site requiring local wound care.

Conclusions: Distraction osteogenesis promotes bone growth and cranial remodeling in patients with craniosynostosis due to rickets. The technique allows for continuous, incremental expansion of both bone and scalp tissue to overcome the limitations of abnormal bone healing due to rickets and inadequate scalp compliance due to older age. Blood loss is a concern in any child undergoing cranial remodeling surgery, and remains so in these cases.

246. Utility of Shunt Assistant to Treat Postural Headache Associated with VP

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Introduction: Shunt overdrainage causing positional headaches is an uncommon but knowncomplication of cerebrospinal fluid shunting that may occur inapproximately 1% of patients. In certain cases overdrainage isaccompanied by positional headaches that improve when supine and areexacerbated when erect. Even with programmable shunts these symptoms canbe difficult to manage.

Methods: Retrospective chart review of 20 patients with symptoms of overdrainagepostural headache. From 2006 to 2013 these patients were identified andtreated with implantation of an in-line shunt assistant to reduce drainageof cerebrospinal fluid. Follow up ranged from 2 months to 7 years. Allpatients had ventriculoperitoneal shunts. The etiology of hydrocephalusincluded myelomeningocele associated hydrocephalus, post-infectious,peri-natal hemorrhage, congenital malformations et cetera.

Results: Symptoms improved or resolved in 17 of 20 patients. The majority these 17patients had nearly immediate relief from positional headaches. Of theremaining three patients one had no improvement in symptoms and twodeveloped signs of underdrainage. One patient that did improvesubsequently required shunt revision four years after placement of shuntassistant and underwent endoscopic third ventriculostomy at that time.

Conclusions: Placement of an in-line shunt assistant device can be an effective methodfor treatment of postural headaches associated with cerebrospinal fluidoverdrainage after ventriculoperitoneal shunt placement.

247. Vascular injury following blunt trauma in the pediatric population: institutional review

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Introduction: Cervicocpehalic arterial dissection associated with blunt trauma is an important but probably unrecognized cause of stroke in children. Very little literature exists in the management of these patients, and in particular the treatment of those patients found to have asymptomatic dissection remains controversial. Data from the adult population mirrors this controversy. We perform an institutional review to investigate the incidence of these injuries and discuss investigative and management strategies.

Methods: Retrospective review of pediatric patients identified through a trauma registry was performed during a 5-year period. Demographics, injury type and management, concomitant injuries, and inpatient outcomes were analyzed.

Results: Twenty-three patients were identified between the ages of 4-18 who were found to have blunt vascular injury, including 14 males and 9 females. The most common mechanism of injury was motor vehicle collision. CT angiography was used as initial screening in all patients, and MR angiography was commonly used for follow-up. Neurological injury was found in two patients screeened related to the vascular injury. One patient required formal angiography with sent assisted coiling of an enlarging pseudoaneurysm.

Conclusions: After blunt trauam advanced imaging and non-invasive angiography should be strongly considered in pediatric patients, especially those patients with identified high-risk features. The presence of arterial injury may prompt a change in management.

248. Vein of Galen Malformations: Proposal of a new classification system

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Introduction: Vein of Galen malformations are a rare and diverse group of entities with a complex anatomy, pathophysiology and serious clinical sequelae. Due to their complexity, there is no uniform treatment paradigm. Furthermore, treatment itself entails serious complication risks. Offering the best treatment option is dependent on understanding of the aberrant anatomy and pathophysiology.

Methods: Literature was searched for any subject related to vein of Galen malformation development, diagnosis, classification, and treatment.

Results: The optimal management of vein of Galen aneurysmal malformations hinges on a correct understanding of the anatomy and pathophysiology of these entities. Current available classification systems are descriptive of the angiographic findings only.

Conclusions: We suggest that arteriovenous malformations should be excluded from this group. A new classification scoring system combining angiographic and clinical presentation is proposed. The utility of this scoring system can be confirmed after validation amongst users.

249. What is the risk to ventriculo-peritoneal shunt survival for both abdominal and clean general surgical procedures?

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Introduction: Ventriculoperitoneal shunt (VPS) dependent children require abdominal surgery for many reasons. Our objective was to quantify the risk of abdominal surgery on VPS survival and to determine whether timing of abdominal intervention impacts on shunt outcome.

Methods: Retrospective data collection was performed on all children undergoing primary VPS insertion or revision over two years (1/1/08 - 31/12/10). All shunt interventions were categorised into two groups: those undergoing additional Abdominal surgery (AS) versus those undergoing Shunt-only (SO). In the AS group, we compared shunt survival for shunts inserted at various Time from abdominal surgery (TAS). Comparison was also made with the groups having clean general surgery (SC) and line insertions (SL).

Results: 342 shunts from 109 patients were included. Twenty patients contributed 118 shunts to the AS group. Median shunt survival was 3.68 months (95% CI=1.01-6.47) and 22.6 months (95% CI = 8.76-36.4) in the AS and SO groups, respectively (log-rank 16.6, $p<0.001$). For each additional abdominal intervention, the risk of shunt failure increased by 57.4% ($p<0.001$). Median shunt survival was 1.48 months (95% CI=0.00-3.09, $p<0.001$) if shunt insertion occurred within one year of abdominal surgery. Beyond one year, median shunt survival increased five-fold to 7.65 months (95% CI=0.00-20.1, log-rank=23.2, $p<0.001$). There was a 29% reduction in risk of shunt failure per year interval between a shunt and abdominal surgery (95% CI=0.11-0.44, $p<0.005$). Our control analysis confirmed that shunts in the AS group had worst survival and infection rates ($P<0.001$).Median shunt survival was 13.3 months (log-rank=1.85, $p=0.174$) and 4.66 months (log-rank=10.3, $p=0.001$) in the SC and SL groups, respectively.

Conclusions: Additional abdominal surgery shortens VPS lifetime and increases risk of infection. Delaying abdominal surgery from a shunt intervention or vice versa by at least one year may prolong shunt survival.

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