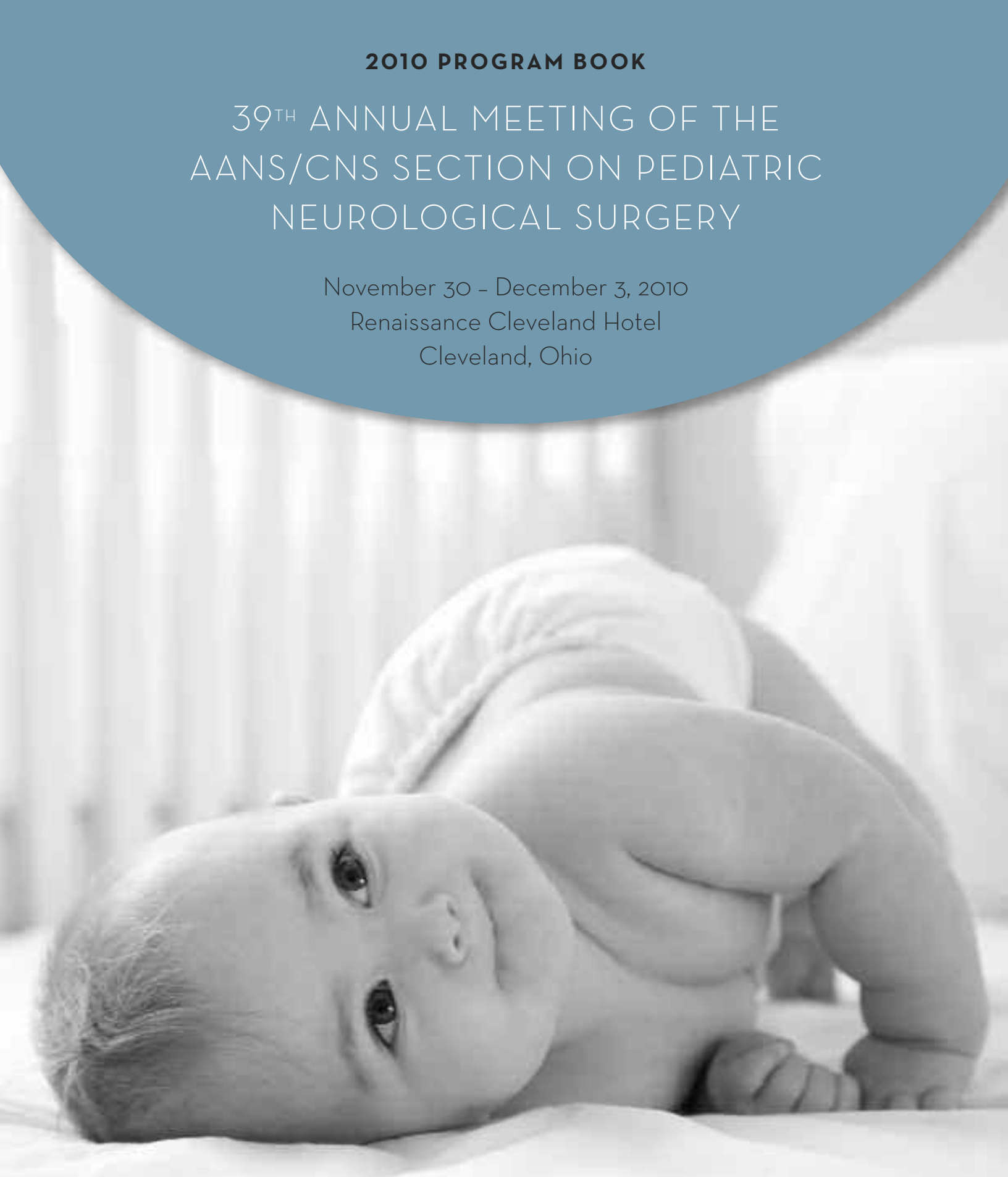
2010 PROGRAM BOOK

39TH ANNUAL MEETING OF THE AANS/CNS SECTION ON PEDIATRIC NEUROLOGICAL SURGERY

November 30 – December 3, 2010
Renaissance Cleveland Hotel
Cleveland, Ohio



Jointly Sponsored by the AANS

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Do not self-report CME credit for the optional pre- and post-meeting ticketed events. By turning in your tickets on-site, credit will automatically be added to your record in MyAANS.org.

AANS/CNS SECTION ON PEDIATRIC NEUROLOGICAL SURGERY

November 30 – December 3, 2010, Cleveland, Ohio

This activity has been planned and implemented in accordance with the Essentials 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 25.75 *AMA PRA Category 1 Credits™*. Physicians should only claim credit commensurate with the extent of their participation in the educational activity.

For the Mid-Level Practitioner's Seminar: This continuing nursing education activity was approved by the Illinois Nurses Association, an accredited approver by the American Nurses Credentialing Center's Commission on Accreditation.

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Neither the content (whether written or oral) of any course, seminar or other presentation in the program, nor the use of specific product in conjunction therewith, nor the exhibition of any materials by any parties coincident with the program, should be construed as indicating endorsement or approval of the views presented, the products used or the materials exhibited by the AANS/CNS Section on Pediatric Neurological Surgery and jointly sponsored by the AANS, or its Committees, Commissions or Affiliates.

ANNUAL MEETING LEARNING OBJECTIVES

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

1. Discuss updates on new therapies of pediatric neurosurgical disorders.
2. Discuss updates on research of congenital and pediatric neurosurgical conditions, and outcome studies.
3. Explain new techniques in the surgical treatment of pediatric and congenital neurosurgical disorders.
4. Discuss implementing protocols for surgical safety.

ANNUAL MEETING SITES

1972 Cincinnati

1973 Columbus

1974 Los Angeles

1975 Philadelphia

1979 New York

1980 New York

1981 Dallas

1982 San Francisco

1983 Toronto

1984 Salt Lake City

1985 Houston

1986 Pittsburgh

1987 Chicago

1988 Scottsdale

1989 District of Columbia

1990 San Diego/ Pebble Beach

1991 Boston

1992 Vancouver, BC

1993 San Antonio

1994 St. Louis

1995 Pasadena

1996 Charleston

1997 New Orleans

1998 Indianapolis

1999 Atlanta

2000 San Diego

2001 New York

2002 Scottsdale

2003 Salt Lake City

2004 San Francisco

2005 Orlando

2006 Denver

2007 South Beach (Miami)

2008 Spokane

2009 Boston

2010 Cleveland

FUTURE MEETING SITE

2011 AUSTIN

November 29 – December 2, 2011

JOINT SECTION ON PEDIATRIC NEUROLOGICAL SURGERY
OFFICERS AND COMMITTEES

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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
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2003–05	Andrew D. Parent
2005-07	Rick Abbott
2007-09	Jeffrey H. Wisoff
2009-11	Ann-Christine Duhaime

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KEYNOTE SPEAKERS

Peter W. Carmel, MD
The Future of Healtcare for Children

Peter W. Carmel, MD, a pediatric neurosurgeon from Newark, NJ, was elected President-Elect of the American Medical Association (AMA) in June 2010, after serving on the AMA Board of Trustees for eight years. A member of the AMA House of Delegates since 1985, Dr. Carmel has served as Chair of the Specialty and Service Society, helping it achieve AMA by-laws recognition. Dr. Carmel has served in numerous positions in both the American Association of Neurological Surgeons (AANS) and the Congress of Neurological Surgeons (CNS). He was the delegate to the AMA from the CNS (1985–2002) and received the AANS Distinguished Service Award in 2008. Born in Brooklyn, NY, Dr. Carmel completed his medical training at the New York University School of Medicine and was a research associate at the National Institutes of Health. He completed his residency in neurosurgery at the Neurological Institute of New York, and obtained his doctorate in neuroanatomy from Columbia University College of Physicians and Surgeons (P&S). Dr. Carmel was on the faculty at P&S for 27 years, and was the founding Chief of the Division of Pediatric Neurosurgery and a Professor of Neurological Surgery.

In 1994, Dr. Carmel moved to the New Jersey Medical School, where he is currently Chair of the Department of Neurological Surgery and Co-medical Director of the Neurological Institute of New Jersey. A noted clinician who operates at the University Hospital in Newark, NJ, he has been named to "Best Doctors in America" (*American Health*), "Best Doctors in New York" (*New York magazine*), "New Jersey Top Doctors" (*New Jersey Monthly*) and "America's Top Doctors" (Castle Connolly). A committed advocate for neurological research, Dr. Carmel served as Chairman of the National Coalition for Research in Neurological Disease and Stroke, and subsequently as Chair of the National Foundation for Brain Research. In addition, he founded the Neuroendocrine Laboratory within the Institute for the Study of Human Reproduction at P&S in 1969. This laboratory has been continuously funded for 41 years. Dr. Carmel has also served on the Board of Directors of the National Patient Safety Foundation and the National Health Museum, and he serves on the New Jersey Commission on Spinal Cord Research.

Dr. Carmel and his wife, Jacqueline Bello, MD, a neuroradiologist, live in Manhattan, NY. Dr. Carmel has three sons.

James T. Rutka, MD, PhD, FRCS
The Future of Pediatric Neurosurgery

James T. Rutka, MD, PhD, FRCS, was named President of the American Association of Neurological Surgeons (AANS) at the AANS Annual Meeting in Philadelphia, May 1-5, 2010. An active member of the AANS since 1983, he has served on the AANS Board of Directors since 2003. He just completed a one-year term as President-Elect and three-year term as Secretary of the AANS. He served as Chair of the 2006 AANS Annual Meeting and Chair of the Scientific Program Committee in 2005. He was the Honored Guest of the Congress of Neurological Surgeons 2009 Annual Meeting. He is a member of the following AANS committees: Executive, Finance, the Neurosurgery Research and Education Foundation Executive Council, NeurosurgeryPAC Board of Directors, and Strategic Planning.

Dr. Rutka has been on the neurosurgical staff at the Hospital for Sick Children in Toronto since 1990. He is currently Co-director of the Arthur and Sonia Labatt Brain Tumour Research Centre. He was appointed Chairman of the Division of Neurosurgery at the University of Toronto in 1999, and the Dan Family Chair that same year. He has been professor in the Department of Surgery at the University of Toronto since 1999. Among his many awards are the Lister Award from the University of Toronto for sustained contributions to surgical research; a Scientist Award from the Medical Research Council of Canada; the Grass Award from the Society of Neurological Surgeons; and Knight of the Order of Smile, Kawaler Orderu Usmiechu.

He received his medical degree from Queen's University Medical School in 1981, followed by residency in neurosurgery at the University of Toronto. He undertook basic science research studies in experimental neuro-oncology at the Brain Tumor Research Center at the University of California at San Francisco where he also received his PhD in experimental pathology from 1984 to 1987. He became a Fellow of the Royal College of Surgeons of Canada in 1989 and pursued clinical and research fellowships in Nagoya and Tokyo, Japan in 1990.

His primary research and clinical interests relate to the treatment of pediatric brain tumors, as well as the surgical treatment of epilepsy in children. Dr. Rutka was a driving force behind the formation of B.r.a.i.n.child, a support group for families whose children are undergoing treatments for brain tumors.

A prolific author, Dr. Rutka has published more than 290 peer-reviewed publications, and over 50 book chapters. He has presented at more than 300 meetings and conferences worldwide.

2010 RAIMONDI LECTURER

Richard C. Karl, MD
The Prevention of Operative Errors

Richard Karl is a native of New York where he received his MD degree from Cornell in 1970. He completed his general surgery residency and post doctoral research training at the Washington University School of Medicine, Barnes Hospital in St. Louis. Dr. Karl was on the surgical faculty at the University of Chicago from 1978-1983 as Assistant and Associate Professor of Surgery.

In 1984, Dr. Karl was appointed as the founding Medical Director of the H. Lee Moffitt Cancer Center & Research Institute in Tampa, Florida. He developed interdisciplinary teams for patient care, teaching, research and was instrumental in developing relationships with the University of South Florida College of Medicine, the Florida state legislature and the community. He implemented the Interdisciplinary Gastrointestinal Tumor Program at the cancer center and served as its leader. He has served the cancer center as Chief of Surgery. He started the Surgical Oncology Fellowship Program at the Moffitt Cancer Center and served as its program director. He specializes in the treatment of cancer of the esophagus, liver, pancreas and stomach. Dr. Karl served as Chair for the Department of Surgery at the University of South Florida from 1999 until 2008.

Along with his academic pursuits, Dr. Karl is an active pilot and a contributing editor to *FLYING Magazine*, where his monthly column "Gear Up," appears. He has combined his two life-long loves, surgery and flying, by founding the Surgical Safety Institute, Inc. (surgicalsafetyinstitute.com) in 2005. The institute assists institutions in their quest for improved patient safety and quality care. His first book, *Across the Redline, Stories from the Surgical Life,* was published in 2002. It has recently been translated into Chinese. He is type rated in Cessna 500 jets and the Boeing 737.

PEDS

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 Maurice 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, PhD
2006 Richard D. Lamm
2007 Roberto C. Heros
2008 Renée Jenkins
2009 Charles Stiles, PhD
2010 Richard C. Karl

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

FRANC INGRAHAM AWARD FOR DISTINGUISHED SERVICE AND ACHIEVEMENT RECIPIENTS

1988 E. Bruce Hendrick
2001 Luis Shut
2004 Fred J. Epstein
2007 Robin P. Humphreys
2009 David G. McLone
2010 Robert Alex Sanford

FRANC INGRAHAM AWARD FOR DISTINGUISHED SERVICE AND ACHIEVEMENT

Robert Alex Sanford, MD

Dr. Robert "Alex" Sanford was born in 1941 in Connecticut and that year his parents moved to Arkansas, his mother's home, when his father took the position of farm manager for Hollywood Plantation. He attended a two room grade school, graduating as the only child in 6th grade and then attended the small town consolidated school nearby. After graduation from Dumas High School he attended Hendrix College on an academic/athletic scholarship, lettering in basketball and swimming. On a hot August night following his sophomore year, God came to him in a vision and told him to "study the human brain" and he switched from engineering to medicine.

He graduated from the University of Arkansas Medical School with AOA honors. He performed neuroscience research, which involved implanting depth electrodes in neurotic bird dogs. After realizing that he was not cut out for psychiatry, or neurology, his first two choices, he decided to be a neurosurgeon and obtained a position at the University of Minnesota. He had never even seen a neurosurgical procedure and this was a straight surgical internship. It became apparent to him that he had little talent as a surgeon. He declined neurosurgery residencies at the University of Minnesota and the University of Tennessee, top programs, to attend the University of Mississippi, at the bottom of the rankings. He made this choice because it offered a large volume of surgery and he hoped that with four/five years of constant surgery, he could learn to operate. He was largely self-taught there, as the only supervision came from fellow residents.

From 1973-1975, he served in the U.S. Army, as a neurosurgeon in Okinawa, Japan. This was during the Vietnam era, but ironically his service involved golf and a small civilian type practice. He returned to the University of Mississippi and became a pediatric neurosurgeon because no one was taking care of the children. During his residency there was a strict bed rationing system and only two beds were allocated for pediatrics, so revision of shunts was impossible. As a resident he called the 45 children listed on note cards for shunt revisions, distal VA shunts at that time, to find only two children still alive. His request for help from the neurosurgery department was refused and he went to the hospital administration and obtained a 36 hour additional bed for shunt revisions. There was no anesthesia coverage, so shunts were revised under local.

In 1985, he was offered the honor of beginning the brain tumor program at St. Jude and joined James C. Simmons, MD, a talented pediatric neurosurgeon, at the Semmes-Murphey Clinic in Memphis.

His aggressive neurosurgical approach was fueled by his self taught background and ever present spiritual guidance on a daily surgical case-by-case basis. He suffered, as we all do, with every permanent surgical complication, but was rewarded as Class I and II data confirmed the value of gross total resection in medullo-blastoma, ependymoma, and low-grade glioma, unheard of in 1985.

SONS SPEAKER

AVROY A. FANAROFF, MB, BCh [RAND), FRCP[E], FRCPCH

Dr. Avroy A. Fanaroff is Professor of Pediatrics and Reproductive Biology at Case Western Reserve University School of Medicine, and first holder of the Eliza Henry Barnes Chair in Neonatology, Rainbow Babies & Children's Hospital. He was educated in South Africa, having received his Doctor of Medicine degree at the University of the Witwatersrand. He is board certified in Pediatrics and Neonatal/Perinatal Medicine, and is a Fellow of the Royal College of Paediatrics and Public Health, London, England.

Dr. Fanaroff is a foremost authority in the field of Neonatal/Perinatal Medicine, and is sought after both nationally and internationally. His publications are too numerous to list. Additionally, he has developed several teaching films/ audiotapes. He has received many awards which include the National Neonatology Education and Virginia Apgar Awards, both presented by the American Academy of Pediatrics, Perinatal Section. Special interests include clinical trials, hyperbilirubinemia, and sepsis.

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 **ADRIANA 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 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. MEADOW**
The Permeable Proximal Catheter Project: A Novel Approach to Preventing Shunt Obstruction

2005 **DAVID CORY ADAMSON**
Digital Karyotyping 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

HYDROCEPHALUS ASSOCIATION AWARD RECIPIENTS

1989 **ERIC ALTSCHULER**
Management of Persistent Ventriculomegaly Due to Altered Brain Compliance

1990 **S.D. MICHOWIZ**
High Energy Phosphate Metabolism in Neonatal Hydrocephalus

1991 **NESHER G. ASNER**
Venous Sinus Occlusion and Ventriculomegaly in Craniectomized Rabbits

1992 **MARCIA DASILVA**
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 Vitro Detection of Fluid Flow in Ventriculoperitoneal 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**
Aberrant Neuronal Development in Hydrocephalus

2003 **MARTIN U. SCHUHMANN, MD, PhD**
Serum and CSF C-Reactive Protein in Shunt Infection Management

2004 **JEFF 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 R. AIR**
A Longitudinal Comparison of Pre- and Postoperative DTI Parameters in Young Hydrocephalic Children

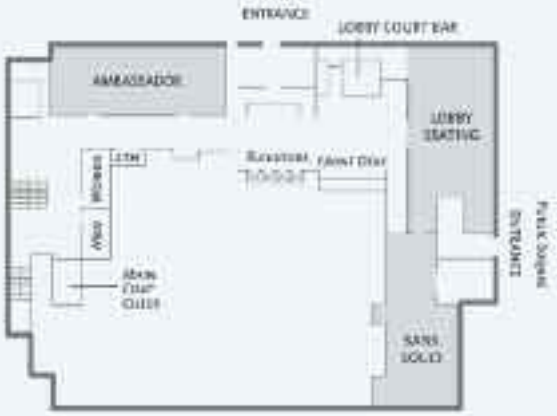
2009 **CHRISTOPHER JANSON**
Immortalization and Functional Characterization of Rat Arachnoid Cells

AANS

FLOOR PLAN – RENAISSANCE CLEVELAND HOTEL

LOWER LOBBY LEVEL
First Floor

LOBBY LEVEL
Second Floor



MEZZANINE LEVEL
Third Floor

CONFERENCE LEVEL
Fourth Floor

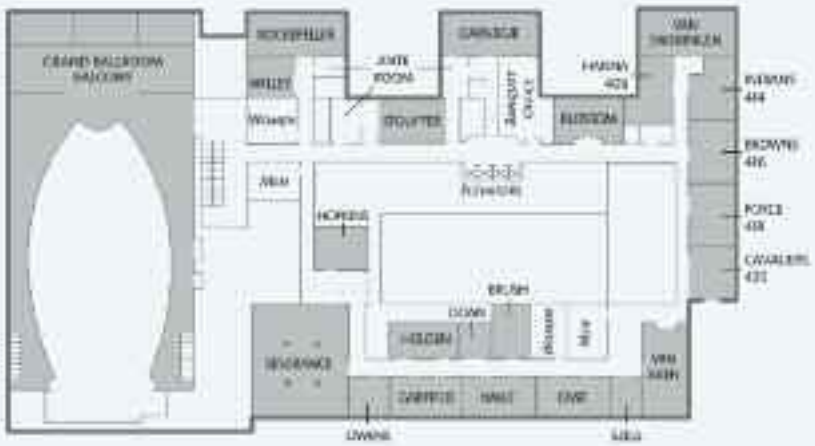
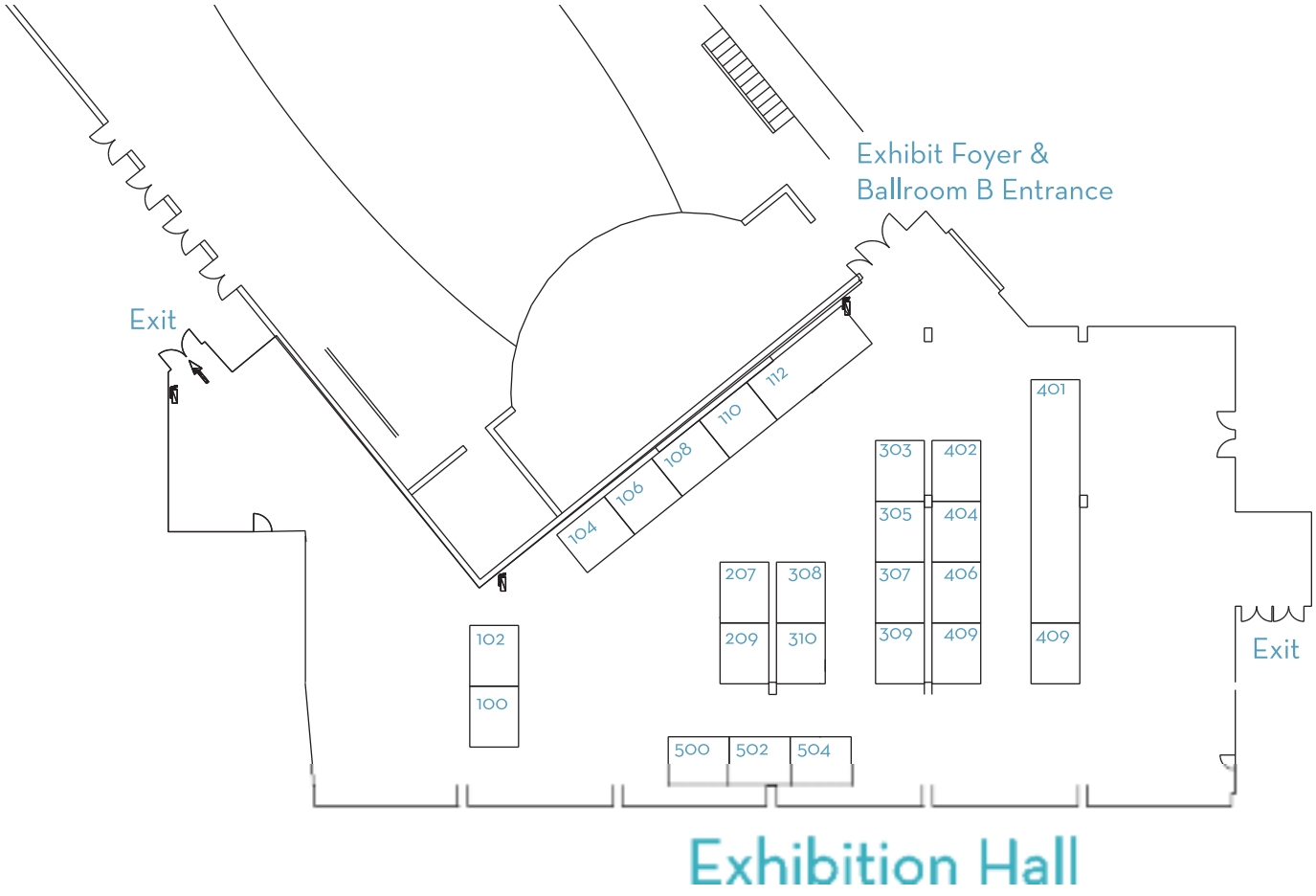


EXHIBIT FLOOR PLAN



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Booth: 209

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Fax: (204)480-7071
www.imris.com
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Fax: (609)275-5363
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Indianapolis, IN 46240
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www.niconeuro.com
Booth: 309

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Cambridge, MA 02139
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Fax: (617)551-8445
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Cleveland, OH 44114
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Fax: (216)881-8504
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Fax: (239)369-2370
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www.rosmansearch.com
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Fax: (610)719-6533
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ACKNOWLEDGEMENTS

The AANS/CNS Section on Pediatric Neurological Surgery thanks the following companies for their support of the Annual Meeting:

Medtronic

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PROGRAM-AT-A-GLANCE

	TIME	EVENT	LOCATION
TUESDAY November 30	7:00 AM – 7:00 PM	Registration	Grand Assembly
	8:00 AM – 4:30 PM	Mid-Level Practitioner's Seminar	Ambassador Ballroom
	6:30 – 8:00 PM	Opening Reception	Shucker's
WEDNESDAY December 1	6:30 AM – 5:30 PM	Registration	Grand Assembly
	6:45 – 7:25 AM	Continental Breakfast in Exhibit Hall	Exhibit Hall
	6:45 AM – 5:30 PM	Exhibit & Poster Viewing	Exhibit Hall
	7:25 AM – 12:00 PM	Scientific Sessions	Grand Ballroom
	9:20 – 9:40 AM	Beverage Break in Exhibit Hall	Exhibit Hall
	12:00 – 1:00 PM	Lunch & Poster Viewing in Exhibit Hall	Exhibit Hall
	1:00 – 4:30 PM	Scientific Sessions	Grand Ballroom
	3:00 – 3:19 PM	Beverage Break in Exhibit Hall	Exhibit Hall
	4:30 – 5:30 PM	Wine & Cheese Reception in Exhibit Hall	Exhibit Hall
THURSDAY December 2	6:30 AM – 5:30 PM	Registration	Grand Assembly
	6:45 – 7:30 AM	Meet the Leadership Breakfast for Residents & Fellows	George Bush Room
	6:45 – 7:30 AM	Continental Breakfast in Exhibit Hall	Exhibit Hall
	6:45 AM – 3:30 PM	Exhibit & Poster Viewing	Exhibit Hall
	7:30 AM – 12:00 PM	Scientific Sessions	Grand Ballroom
	9:30 – 10:00 AM	Beverage Break in Exhibit Hall	Exhibit Hall
	12:00 – 1:00 PM	Lunch & Poster Viewing in Exhibit Hall	Exhibit Hall
	1:00 – 5:00 PM	Scientific Sessions	Grand Ballroom
	2:50 – 3:09 PM	Beverage Break in Exhibit Hall	Exhibit Hall
	5:00 – 5:30 PM	Annual Business Meeting	Grand Ballroom
	6:30 – 10:00 PM	Pediatric Neurosurgery Rocks Cleveland	Rock and Roll Hall of Fame
FRIDAY December 3	6:30 – 11:00 AM	Registration	Grand Assembly
	6:45 – 7:30 AM	Continental Breakfast in Exhibit Hall	Exhibit Hall
	6:45 – 10:30 AM	Exhibit & Poster Viewing	Exhibit Hall
	7:30 AM – 12:00 PM	Scientific Sessions	Grand Ballroom
	10:00 – 10:20 AM	Beverage Break in Exhibit Hall	Exhibit Hall

NOTE: All dates, times and room locations are subject to change.

CLEVELAND

PROGRAM DESCRIPTIONS

The open scientific sessions provide participants exposure to the latest in research and groundbreaking information available on neurosurgical topics. This year's meeting will feature Special Sessions that take a look at controversial topics, and are discussed by selected experts. Additional scientific programming will have state-of-the-art updates on selected topics, given by experts in the field.

Mid-Level Practitioner's Seminar

A pre-meeting Mid-Level Practitioner's Seminar will be held on Tuesday, November 30 from 8:00 AM – 4:30 PM. This year's course will include a variety of topics presented by a number of invited speakers. A continental breakfast and boxed lunch are included with registration. For the Mid-Level Practitioner's Seminar: This continuing nursing education activity was approved by the Illinois Nurses Association, an accredited approver by the American Nurses Credentialing Center's Commission on Accreditation.

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

Neurological Assessment, Diagnosis and Treatment

1. Review neurological assessment in the pediatric patient
2. Identify normal variations in neurological exam in children
3. Review management of patient with abnormal neurological findings

Neurophysiological Intraoperative Monitoring from Head to Cauda Equina

1. Determine which procedures to monitor
2. Determine which modality or modalities are appropriate
3. Understand the efficacy for intra-operative monitoring

Advances in Craniosynostosis Surgery

1. Determine which patients would benefit from minimally invasive or open repair of craniosynostosis
2. Explain the differences between the minimally invasive or open repair of craniosynostosis
3. Examine the use of erythropoietin in cranial vault repair

Surgical Management of Epilepsy

1. Recognize when to refer a child with epilepsy for surgical evaluation
2. Describe the available surgical evaluation and treatment options for epilepsy syndromes in children
3. Describe the expected outcomes of common surgical treatments for epilepsy
4. Review the surgical management of patients with epilepsy

Pediatric Athletic Concussion: When Can They Return to Play?

1. Discuss the pathophysiology of pediatric athletic concussion and the sports that place the athlete at risk
2. Evaluate current methods for evaluating concussion severity
3. Review return to play guidelines

Unusual Findings in the Postoperative Shunted Patient

1. Identify three important observations to be included in the physical examination of the postoperative shunted patient
2. Identify at least two findings that would require immediate follow up

Pediatric Supratentorial Brain Tumors

1. Review common clinical presentations for three main categories of supratentorial brain tumors
2. Evaluate operative management, surgical technique, and complication avoidance
3. Review post-operative management and follow-up for common supratentorial brain tumors

A Nursing Perspective: A Case Series of Three Pediatric Neuroscience Patients with DVT's and CVL's

1. Describe two risk factors for pediatric patients with femoral vein central venous lines
2. Describe pre and post care of three pediatric patients in relation to femoral line and DVT management
3. Identify two future recommendations for prevention of DVT in the pediatric population

Exhibit Viewing and Poster Sessions

Vendors and their exhibitors afford meeting participants an excellent opportunity to view highly specialized equipment and observe first-hand demonstrations of the latest technology available in pediatric neurosurgery.

Poster presentations give interested parties an opportunity to study at their leisure and, at length, the most cutting-edge research performed and documented by leaders in pediatric neurosurgery.

Opening Reception

The opening reception will take place on Tuesday, November 30 from 6:30 – 8:00 PM at Shucker's, at the Renaissance Cleveland Hotel. Enjoy spending the evening with friends and colleagues over a wonderful assortment of hors d'oeuvres and open bar. All registered attendees and registered guests/spouses receive one complimentary ticket to this event. Business casual attire suggested.

PEDIATRIC NEUROSURGERY ROCKS CLEVELAND!

Pediatric Neurosurgery Rocks Cleveland
Thursday, December 2
Rock and Roll Hall of Fame
6:30 – 10:00 PM

Join us for the Section Banquet and an unforgettable evening at the iconic Rock and Roll Hall of Fame on Thursday, December 2. Enjoy cocktails, dinner and a live band. Tour the museum at your leisure throughout the evening. Meet Terry Stewart, President of the Rock and Roll Hall of Fame, who will provide us with behind the scenes details.

This event is not to be missed! The fee, an incredible bargain, includes admission to the full museum ($22 value), cocktails, dinner, dancing and priceless entertainment. The gift shop will remain open for the first two hours.

Medical Attendees: $50 Spouse/Guest: $50

PROGRAM SCHEDULE

TUESDAY, NOVEMBER 30

7:00 AM – 7:00 PM
Registration
Grand Assembly

7:00 – 10:30 AM
ABPNS Board Meeting
George Bush Room

8:00 AM – 4:30 PM
Mid-Level Practitioner's Seminar
Ambassador Ballroom

10:30 AM – 2:30 PM
ABPNS Examination
Severance Room

12:00 – 4:30 PM
AANS/CNS Section on Pediatric Neurological Surgery Executive Committee Meeting
Van Aken

4:00- 6:00 PM
Speaker Ready Room
Willey Room

4:30- 6:00 PM
Education Committee Meeting
George Bush Room

6:30 – 8:00 PM
Opening Reception
Shucker's
See page 16 for details

Mid-Level Practioner's Seminar

8:00 – 8:15 AM
Welcome and Introductions
Heather Schober, RN, MS, CPNP

8:15 – 9:15 AM
Neurological Assessment, Diagnosis and Treatment
Nancy Bass, MD

9:15 – 10:00 AM
Neurophysiological Intraoperative Monitoring from Head to Cauda Equina
Sheryl Nehamkin, R.EEG/EP T., CNIM, CLTM

10:00 – 10:15 AM
Break

10:15 – 11:00 AM
Advances in Craniosynostosis Surgery
Ann M. Ritter, MD

11:00 – 11:45 AM
Surgical Management of Epilepsy
Patti Batchelder, RN, MSN, CPNP

11:45 AM – 1:00 PM
Lunch and Networking

1:00 – 1:45 PM
Pediatric Athletic Concussion: When Can They Return to Play?
Cathy Cartwright, RN, MSN

1:45 – 2:30 PM
Unusual Findings in the Postoperative Shunted Patient
Donna Wallace, RN, MS, CPNP

2:30 – 2:45 PM
Break

2:45 - 3:30 PM
Pediatric Supratentorial Brain Tumors
Nicholas Wetjen, MD

3:30 – 4:15 PM
A Nursing Perspective: A Case Series of Three Pediatric Neuroscience Patients with DVT's and CVL's
Emily Snider, BSN, MSN, RN, FNP-BC
Tracy Tidwell, BSN, MSN, APN

4:15 - 4:30 PM
Wrap-up and Evaluations

WEDNESDAY, DECEMBER 1

6:30 AM – 5:30 PM
Registration
Grand Assembly

6:30 – 7:30 AM
Accreditation Council Meeting
Wade Room

6:45 – 7:25 AM
Continental Breakfast
Exhibit Hall

7:00 AM – 4:00 PM
Speaker Ready Room
Willey Room

7:25 – 7:30 AM
Welcome and Opening Remarks
Ann-Christine Duhaime, MD

PROGRAM SCHEDULE

7:30 – 8:00 AM
Special Session I: Future, Quality & Outcomes
James T. Rutka, MD, PhD
Thomas G. Luerssen, MD
Moderator: David P. Gruber, MD

8:00 – 9:20 AM
Scientific Session I: Hydrocephalus
Moderators: Liliana C. Goumnerova, MD, FRCS(C); Daniel James Guillaume, MD

1. A Method to Explain the Variation in Reported ETV Success among Published Case Series of Childhood Hydrocephalus
Abhaya V. Kulkarni (Toronto, Canada); Jay Riva-Cambrin, MD, MSc (Salt Lake City, UT); Samuel R. Browd, MD, PhD (Seattle, WA)

2. Effects of Early and Late Reservoir Treatment in Experimental Neonatal Hydrocephalus
Ramin Eskandari, MD, MS; Osama Abdullah, BS; Eric C. Burdett, DVM; Chase Bryan; Kristina Carlson, BS; Kelley Deren, MS; Melissa Packer, BS; Edward W. Hsu, PhD; Pat McAllister, PhD (Salt Lake City, UT)

3. Effectiveness of Endoscopic Third Ventriculostomy and Ventriculoperitoneal Shunt Placement in the Treatment of Hydrocephalus
Sarah Jernigan, MD, MPH; Dionne Graham, PhD; Jay Berry, MD; Liliana Goumnerova, MD (Boston, MA)

4. Ventriculocystocisternostomy is an Effective Treatment for Suprasellar Arachnoid Cysts
Cormac O. Maher, MD (Ann Arbor, MI); Liliana Goumnerova, MD (Boston, MA)

5. Third Ventricular Shape: A Predictor of Endoscopic Third Ventriculostomy Success
Mansoor Foroughi, MBBS, FRCS; David D. Cochrane, MD, FRCS; Andrew Wong, BSC; Paul Steinbok, MBBS, FRCS; Ash Singhal, MD, FRCS; Michael Sargent, MD, FRCS (Vancouver, Canada)

6. Assessing Premature Infants for Findings of Increased Intracranial Pressure: An HCRN Inter-Rater Reliability Study
John C. Wellons III, MD (Birmingham, AL); Jay Riva-Cambrin, MD, MSc (Salt Lake City, UT); William Whitehead, MD, MPH (Houston, TX); Samuel Browd, MD, PhD (Seattle, WA); John Kestle, MD, MSc (Salt Lake City, UT); Abhaya Kulkarni, MD, PhD (Toronto, Canada)

7. Malfunction Rates in Antibiotic-Impregnated Versus Non-Antibiotic-Impregnated Proximal CSF Shunt Catheters
Naina L. Gross, MD; Ryan Rahhal, MD (Oklahoma City, OK)

8. Efficacy and Safety of Ultrasound Guided Shunt Insertion
William E. Whitehead, MD, MPH; A. Illner, MD; R. Holubkov, MD; J. Riva-Cambrin, MD; A. Kulkarni, MD,; J. Wellons, MD; T. Simon, MD; S. Browd, MD; J. Drake, MD; T. Luerssen, MD; J. Oakes, MD; M. Walker, MD; J. Kestle, MD (Houston, TX);

9:20 – 9:39 AM
Beverage Break in the Exhibit Hall

9:40 – 9:59 AM
State of the Art I: Vascular Lesions
R. Michael Scott, MD

10:00 – 11:30 AM
Scientific Session II: Vascular
Moderators: Cormac O. Maher, MD; Nicholas M. Wetjen, MD

9. Outcomes of Modern Endovascular Treatment of Vein of Galen Malformations
Alejandro Berenstein, MD; Yasunari Niimi, MD; Johanna Fifi, MD; Rafael Ortiz, MD; Salvatore Presti, MD; Saadi Ghatan, MD; Michelle Sorscher, RN; Mary Madrid, RN; Walter Molofsky, MD (New York, NY)

10. An Assessment of Concurrent Aneurysms in the Presentation and Treatment of Pediatric Brain Arteriovenous Malformations
Christopher P. Kellner, MD; Michael M. McDowell, BS; Geoffrey Appelboom, MD; Ivan Kotchetkov, BS; Raqeeb Haque, MD; Neil A. Feldstein, MD, FACS; E. Sander Connolly Jr., MD, FACS; Robert A. Solomon, MD, FACS; Philip M. Meyers, MD; Sean D. Lavine, MD; Richard C.E. Anderson, MD, FACS (New York, NY)

11. Intracranial Aneurysms in Childhood
Nalin Gupta, MD, PhD; Steven W. Hetts, MD; Heather J. Fullerton, MD, MSc; Michael T. Lawton, MD; Randall T. Higashida, MD; Christopher F. Dowd, MD; Van V. Halbach, MD (San Francisco, CA)

12. Intraoperative Angiography during Microsurgical Resection of Arteriovenous Malformations in Children
Michael J. Ellis, MD; Abhaya Kulkarni, MD, PhD; James Drake, MD, MSc; James Rutka, MD, PhD; Derek Armstrong, MD; Peter Dirks, MD, PhD (Toronto, Canada)

13. Multimodality Therapy of Pediatric Intracranial Arteriovenous Malformations
Raphael Guzman, MD; Tim E. Darsault, MD; Michael S.B. Edwards, MD; Mary L. Marcellus, RN; Lu Tian, PhD; Huy M. Do, MD; Steven D. Chang, MD (Stanford, CA); Richard P. Levy, MD, PhD (Loam Linda, CA); John R. Adler, MD; Michael P. Marks, MD; Gary K. Steinberg, MD, PhD (Stanford, CA)

14. Surgical Management of the Symptomatic, Enlarging, Isolated Fourth Ventricle
Yasser Jeelani, MD; Hui-ju Liu, MD; Ira Bowen, BA; Mark D. Krieger, MD; J. Gordon McComb,MD (Los Angeles, CA)

15. Variations in the Neurosurgical Care of Premature Infants with Intraventricular Hemorrhage: A Multicenter Study
Jay K. Riva-Cambrin (Salt Lake City, UT); Jay Wellons, MD (Birmingham, AL); Abhaya Kulkarni, MD,FRCS(C) (Toronto, Canada); John Kestle, MD,FRCS(C) (Salt Lake City, UT); William Whitehead, MD (Houston, TX); Sam Browd, MD; Tamara Simon, MD (Seattle, WA)

16. Post-Hemorrhagic Hydrocephalus in Neonatal Mice: High Resolution In-Vivo Magnetic Resonance Imaging and Histology
Edward S. Ahn, MD; Jiangyang Zhang, MD; Edison Leung, MS; David Ibrahimi, MD; Mary Ann Wilson, PhD; Hye In Kim, BS; Do Yeon Kim, BS; Michael V. Johnston, MD; Ali Fatemi, MD (Baltimore, MD)

17. Risk of Shunt Failure Related to Cerebrospinal Fluid Parameters in Premature Infants with Post-Hemorrhagic Hydrocephalus
Daniel H. Fulkerson, MD; Bradley N. Bohnstedt, MD (Indianapolis, IN); Shobhan Vachhrajani, MD (Toronto, Canada); Akash J. Patel, MD; Benjamin D. Fox, MD (Houston, TX); Neal B. Patel, MD ; Andrew Jea, MD (Houston, TX); Joel C. Boaz, MD (Indianapolis, IN)

11:30 – 12:00 PM
Keynote Address
Peter W. Carmel, MD
President-Elect of The American Medical Association
The Future of Healthcare for Children

12:00 – 1:00 PM
Lunch in the Exhibit Hall

1:00 – 2:10 PM
Raimondi Lecture
Richard C. Karl, MD
The Prevention of Operative Errors

2:10 – 3:00 PM
Scientific Session III: Epilepsy
Moderators: Matthew D. Smyth, MD; Howard L. Weiner, MD

18. Quality of Life Changes Following Pediatric Epilepsy Surgery
Amy Lee, MD; Jeffrey Titus, PhD; David Limbrick, MD, PhD; Liulin Thio, MD; Jennifer Rogier, BA; Matthew Smyth, MD (Saint Louis, MO)

19. Perioperative Seizure Incidence and Risk Factors in 223 Pediatric Brain Tumor Patients without Prior Seizures
Douglas A. Hardesty, BA; Matthew R. Sanborn, MD; Whitney E. Parker, BA; Leslie N. Sutton, MD; Phillip B. Storm, MD (Philadelphia, PA)

20. Functional MRI and Tractography of Visual Pathways for Pre-Surgical Planning in Sedated and Awake Children
Frederick A. Boop, MD; Robert Ogg, PhD, MD; matthew Scoggins, PhD; Stephanie Einhaus, MD; Paul Klimo, MD, MPH; Mason Shifflet, MD; James A. Wheless, MD (Memphis, TN)

21. Surgical Treatment of Refractory Status Epilepticus in Children
Sanjiv Bhatia; John Ragheb, MD, FACS; Prasanna Jayakar, MD; Ian Miller, MD (Miami, FL)

22. Vagus Nerve Stimulation for Children with Medically-Intractable Epilepsy: A Consecutive Series of 141 Children 18 Years of Age or Less
Luigi Bassani, MD; Robert Elliott, MD; Shaun Rodgers, MD; Amr Morsi; Eric Geller; Chad Carlson, MD; Orin Devinsky, MD; Werner Doyle, MD (New York, NY)

3:00 – 3:19 PM
Beverage Break in the Exhibit Hall

3:20 – 3:39 PM
State of the Art II: Spine
Douglas L. Brockmeyer, MD

3:40 – 4:30 PM
Scientific Session IV: Spine
Moderators: Andrew H. Jea, MD; Sean M. Lew, MD

23. Complex Pediatric Cervical Spine Surgery Using Smaller Non-Traditional Screws and Plates
Mahesh Karandikar, MD, PhD; Anthony Avellino, MD, MBA; Tong Yang, MD, PhD; Wally Krengel, MD; Kit Song, MD; Sohail Mirza, MD (Seattle, WA)

24. Motion Segment Sparing Repair of Symptomatic Chronic Pars Defects
Ian S. Mutchnick, MD, MS; Travis Clegg, MD; Leah Y. Carreon, MD, MHSc; Rolando M. Puno, MD (Louisville, KY)

25. The Use of the Inside-Outside Fixation Technique for Pediatric Occipitocervical Fusion
Eric A. Sribnick, MD, PhD; Vladimir Y. Dadashev, MD; Barunashish Brahma, MD; David M. Wrubel, MD (Atlanta, GA)

26. Surgical Management of Non-Traumatic, Subaxial Cervical Spine Deformity/Instability in Children Utilizing Rigid Internal Fixation Constructs
Ian S. Mutchnick, MD; Charles B. Stevenson, MD; Alvin H. Crawford, MD; A. Atiq Durrani, MD; Francesco T. Mangano, DO (Cincinnati, OH)

27. When Can We not Screen Infants for Tethered Spinal Cord? An Analysis of Presenting Factors in 1141 Infants
Jennifer Kirkman, BS; Joshua Chern, MD, PhD; Chevis Shannon, PhD; Toren Anderson, MD; Richard S. Tubbs, PhD; Curtis Rozzelle, MD; John C. Wellons III, MD (Birmingham, AL)

4:30 – 5:30 PM
Wine & Cheese Reception in the Exhibit Hall
Exhibit Hall

THURSDAY, DECEMBER 2

6:30 AM – 5:30 PM
Registration
Grand Assembly

6:45 – 7:30 AM
Meet the Leadership Breakfast for Residents and Fellows
George Bush Room

6:45 – 7:30 AM
Continental Breakfast
Exhibit Hall

7:00 AM – 4:00 PM
Speaker Ready Room
Willey Room

7:30 – 8:00 AM
Special Session II: Head Trauma
John A. Jane Sr., MD, PhD
Richard G. Ellenbogen, MD, FACS
Moderator: David W. Pincus, MD, PhD

8:00 – 9:30 AM
Scientific Session V: Trauma
Moderators: Gerald A. Grant, MD; Catherine Anne Mazzola, MD

28. Validity of Rapid Sequence Magnetic Resonance Imaging in Pediatric Brain Trauma
Dhruve S. Jeevan, MD; Jayson A. Neil, MD; Jennifer Ronecker, BS; Avinash Mohan, MD; Michael Tobias, MD (Valhalla, NY)

29. Intraarterial Delivery of Human ES Derived Neural Stem Cells in a Neonatal Rat Model of Hypoxic-Ischemia Leads to Functional Recovery
Sahar Rosenblum, BS; Joshua Y. Chua, BS; Tenille N. Smith, MD; Nancy Wang, BS; Hotaik Sung; Raphael Guzman, MD (Stanford, CA)

30. The Impact of Attention Deficit- Hyperactivity Disorder on Recovery from Closed Head Injury
Christopher M. Bonfield, MD; Stephanie Greene, MD (Pittsburgh, PA)

31. The Pediatric Cervical Spine Instability Study
Douglas L. Brockmeyer, MD (Salt Lake City, UT); Brian Ragel, MD (Portland, OR); John Kestle, MD, MSc (Salt Lake City, UT)

32. Modern Multimodality Management of Aneurysmal Bone Cysts of the Spine in Children
Shobhan H. Vachhrajani, MD; Michael Ellis, MD; Gregory Albert, MD; Abhaya V. Kulkarni, MD, PhD; Peter B. Dirks, MD, PhD; James T. Rutka, MD, PhD; Reinhardt Zeller, MD; Derek Armstrong, MD; James M. Drake, MD (Toronto, Canada)

33. Retrospective Study of Spinal Metastasis of Pilocytic Astrocytoma
Joseph Chung, BS; Mark Krieger, MD; Ira Bowen, BA; Yasser Jeelani, MD; J Gordon McComb, MD (Los Angeles, CA)

34. A Retrospective Study on the Survivability of Children with Ependymomas from 1975-2000
Maureen A. Darwal, BA; Bradley T. Bagan, MD; Mirza N. Baig, MD, PhD; Robert A. Hirschl, MD; Chris S. Karas, MD (Des Moines, IA)

35. Intraventricular Lesions in Tuberous Sclerosis Complex: A Possible Association with the Caudate Nucleus
Howard L. Weiner, MD; Joel S. Katz, BA; Sarah Milla, MD; Graham Wiggins, PhD; Orrin Devinsky, MD (New York, NY); Jonathan Roth, MD (Israel, Tel Aviv)

36. Poorly Differentiated Chordomas Commonly Lose INI1 Expression: A Clinicopathologic Study of 4 Cases with Comparison to Typical Chordoma and Atypical Teratoid Rhabdoid Tumor
Melanie G. Hayden, MD; Bret C. Mobley, MD; Katherine Callahan, MD; Jesse K. McKenney, MD; Athena M. Cherry, PhD; Dana C. Bangs; Kristen W. Yeom, MD; Paul G. Fisher, MD; Michael S.B. Edwards, MD; Hannes Vogel, MD (Stanford, CA)

9:30 – 10:00 AM
Beverage Break in the Exhibit Hall

10:00 – 10:30 AM
Section on Neurological Surgeons of the American Academy of Pediatrics Special Lecturer
Avroy Fanaroff, MD
Improving the Care of the High Risk Neonate

10:30 AM – 12:00 PM
Scientific Session VI: Trauma
Moderators: Hugh J.L. Garton, MD, MHSc; John A. Jane Jr., MD

37. Mini-Craniotomy Versus Burr Hole for Evacuation of Chronic Subdural Collections in Infants
Paul Klimo, MD, MPH (Memphis, TN); Anne Matthews, NP; Sean Lew, MD; Marike Zweinenberg-Lee, MD; Bruce A. Kaufman, MD (Milwaukee, WI)

38. Traumatic Spinal Injuries in Children
Michael Vassilyadi, MD, FRCSC; Christopher Kim, MSc; Paul Moroz, MD (Canada, Ottawa)

39. Cranioplasty Following Decompressive Craniectomy of Traumatic Brain Injury in the Pediatric Population
Margaret Riordan, MD (Syracuse, NY)

40. Temporary Shunts in Young Children
Julian J. Lin, MD; Brandon J. Bond, BA; William C. Lee, MD (Peoria, IL)

41. The Effect of Gel Film on Retethering of Complex Closed Neural Tube Defects
Jesse Winer, MD; Daniel Solchanyk, BS; Ira Bowen, BA; Alex Tuchman, MD; Mark Krieger, MD; J Gordon McComb, MD (Los Angeles, CA)

42. Citrobacter Brain Abscesses in Neonates: The Importance of Early Diagnosis and Aggressive Surgical Intervention
Shakeel A. Chowdhry, MD; Alan R. Cohen, MD (Cleveland, OH)

43. Repeated Cerebrospinal Fluid (CSF) Shunt Infections in Children
Tamara D. Simon, MD, MPH (Seattle, WA); Teresa J. Tuan, MD (San Francisco, CA); Nicole Mayer-Hamblett, PhD (Seattle, WA); John RW Kestle, MD, MSc; Emily A. Thorell, MD (Salt Lake City, UT)

44. Clinical Symptoms are Equivalent to Imaging in Predicting Shunt Failure in Myelomeningocele Patients
Jeffrey P. Blount, MD; Gavin T. Reed, BS; Chevis N. Shannon, PhD; Curtis J. Rozzelle, MD; John C. Wellons, MD; R S. Tubbs, PhD, PA-C; Jerry Oakes, MD (Birmingham, AL)

45. Cost-Effectiveness of Ventriculoperitoneal Shunting in Ethiopia
Jared D. Ament, MD, MPH (Worcester, MA); Yohans Wodaje, MD (Ethiopia, Addis Ababa); Richard Moser, MD, FACS (Worcester, MA); Peter M. Black, MD, PhD (Boston, MA)

12:00 – 1:00 PM
Lunch in the Exhibit Hall

1:00 – 1:20 PM
State of the Art III: Craniofacial Surgery
David F. Jimenez, MD, FACS

1:20 – 2:50 PM
Scientific Session VII: Craniofacial
Moderators: Robert F. Keating, MD; Mark R. Proctor, MD

46. The Saint Louis Children's Hospital Experience with Endoscopically Assisted Sagittal Synostosis Repair
Manish N. Shah, MD; Amy Lee, MD (St. Louis, MO); Jason D. Petersen, MD (Oklahoma City, OK); Sybill Naidoo, NP; Albert S. Woo, MD; Alex A. Kane, MD; Matthew D. Smyth, MD (St. Louis, MO)

47. Use of Molding Helmet as Primary Treatment of Sagittal Craniosynostosis
Sandeep Sood, MD; Steven D. Ham, DO; Arlene Rozelle, MD (Detroit, MI)

48. Radiation Dose Reduction in Children Undergoing CT Imaging for Craniofacial Surgery
Nathan R. Selden, MD, PhD; Ryne A. Didier, BA; Anna A. Kuang, MD; Daniel L. Schwartz, MD; Donna M. Stevens, MD; Dianna ME Bardo, MD (Portland, OR)

49. Intraoperative Estimated Blood Loss Assessment is Unreliable in Extended Synostectomies
Mitchel Seruya, MD; Robert F. Keating, MD; Michael J. Boyajian, MD; John S. Myseros, MD; Amanda L. Yaun, MD; Albert K. Oh, MD (Washington, DC)

50. Efficacy of Hydromer-Coated Shunt Systems in Reducing Early Shunt Infections
Emil A. Pastrana, MD; Gisela Murray, MD; Samuel Estronza, MD; Ivan J. Sosa, MD (San Juan, PR)

51. Normative Brain and CSF Volume Growth Curves for Evaluating Hydrocephalus
Jason G. Mandell, MS; Jacob Langelaan, PhD; Andrew G. Webb, PhD; Steven J. Schiff, MD, PhD (University Park, PA)

52. Brain and CSF Volumes Discriminate Neurocognitive Outcomes in Hydrocephalus
Jason G. Mandell, MS (University Park, PA); Abhaya Kulkarni, MD, PhD (Toronto, Canada); Benjamin C. Warf, MD (Boston, MA); Steven J. Schiff, MD, PhD (University Park, PA)

53. Endoscopic Third Ventriculostomy for Tectal Plate Gliomas: Long-Term Outcomes and Ventricular Size
Andrew K. Romeo; Rob Naftel, MD; Gavin Reed, MS; Richard Martin, MD; Chevis Shannon, PhD; Paul Grabb, MD; R Shane Tubbs, PhD; John Wellons, MD (Birmingham, AL)

54. Hyponatremia Following Endoscopic Third Ventriculostomy: A Report of Five Cases and Analysis of Risk Factors
Gregory G. Heuer, MD, PhD; Joel A. Bauman, MD; Michael W. Aversano, BS; Matthew R. Sanborn, MD; Arastoo Vossough, MD; Leslie N. Sutton, MD; Phillip B. Storm, MD (Philadelphia, PA)

2:50 – 3:09 PM
Beverage Break in the Exhibit Hall

3:10 – 3:29 PM
State of the Art IV: Chiari I Decompression: 2010
Karin M. Muraszko, MD

3:30 – 5:00 PM
Scientific Session VIII: Congenital
Moderators: Saadi Ghatan, MD; Bermans J. Iskandar, MD

55. Complex Chiari 1 Malformations in Children: Analysis of Preoperative Risk Factors for Occipital-Cervical Fusion
Robert J. Bollo, MD; Meghan M. Brockmeyer; Jay Riva-Cambrin, MD; Douglas L. Brockmeyer, MD (Salt Lake City, UT)

56. Natural History of Chiari I Malformation after Recommendation for Conservative Management
Jennifer Strahle, MD; Joseph Kapurch, BS; Mohannad Ibrahim, MD; Karin M. Muraszko, MD; Hugh JL Garton, MD, MHSc; Cormac O. Maher, MD (Ann Arbor, MI)

57. A Collaborative Effort to Improve Treatment Outcomes: The Park - Reeves Syringomyelia Research Consortium
David D. Limbrick, MD, PhD; T.S. Park, MD (St. Louis, MO)

58. The Chiari 0 Malformation Revisited
Joshua J. Chern, MD, PhD; Shane Tubbs, PhD; Jerry Oakes, MD (Birmingham, AL)

59. Folic Acid Supplementation Enhances CNS Regeneration In Vitro on Inhibitory CNS Myelin
Krista Stewart, BA; Logan Gorges, BS; Bermans J. Iskandar, MD (Madison, WI); Elias Rizk, MD (Hershey, PA); Nithya Hariharan, MD (Madison, WI)

60. Magnetic Resonance Imaging Versus Ultrasonography for the in Utero Evaluation of Central Nervous System Anomalies
Pierpaolo Peruzzi, MD; Corey Raffel, MD, PhD (Columbus, OH)

61. Recurrence of Syringomyelia in Chiari I Etiology: Arachnoid Veil
James M. Shiflett, MD; Michael Muhlbauer, MD; Stephanie Einhaus, MD; Fredrick Boop, MD; Robert A. Sanford, MD (Memphis, TN)

62. Is Chiari Syndrome without Chiari Malformation Proof of an Anatomical Basis for Chiari Symptomatology?
Ricky Wong, MD; Leila Khorsani, MD; David Frim, MD (Chicago, IL)

63. Intraventricular Versus Intrathecal Baclofen for Dystonia: A Comparison of Complications
Brandon G. Rocque, MD; A Leland Albright, MD (Madison, WI)

5:00 – 5:30 PM
Annual Business Meeting
Grand Ballroom

6:30 – 10:00 PM
Pediatric Neurosurgery Rocks Cleveland
Rock & Roll Hall of Fame
See page 16 for details

FRIDAY, DECEMBER 3

6:30 – 11:00 AM
Registration
Grand Assembly

6:45 – 7:30 AM
Continental Breakfast

7:00 – 11:00 AM
Speaker Ready Room
Willey Room

7:30 – 7:49 AM
Special Session III: Tumor
Robert A. Sanford, MD
Moderator: Corey Raffel, MD, PhD

7:50 - 7:59 AM
Research Grant Awards
Ann-Christine Duhaime, MD

8:00 - 9:50 AM
Scientific Session IX: Tumors
Moderators: Michael Handler, MD, FACS; Mark M. Souweidane, MD

64. Dosimetry of 124I-8h9 Convection-Enhanced Delivery for Potential Therapy in Diffuse Intrinsic Pontine Glioma
Neal Luther, MD; Zhiping Zhou, MD; Pat Zanzonico, PhD; Nai-Kong Cheung, MD, PhD; John Humm, PhD (New York, NY)

65. Effective Treatment of Disseminated Medulloblastoma with Modified Measles Virus in a Murine Model
Corey Raffel; Adam Studebaker, PhD (Columbus, OH)

66. Management of Diffuse Intrinsic Pontine Glioma: Results of a Practice Survey
Michael H. Handler, MD; Nicholas K. Foreman, MB (Aurora, CO)

67. Radiographic Features Which Predict Lack of Complete Response to Chemotherapy in Pediatric Intracranial Germinomas
Jamie Botelho, BS; Mark Krieger, MD; Ira Bowen, BA; Yasser Jeelani, MD; J Gordon McComb, MD (Los Angeles, CA)

68. Focal Brain Stem Gliomas
Robert A. Sanford, MD; A Chavez, MD; Frederick A. Boop, MD; G T. Armstrong, MD; Paul Klimo, MD, MPH (Memphis, TN)

69. Congenital Glioblastoma Multiformas: A Retrospective Review
Alya Hasan, MD, FRCSC; Margaret Macy, MD; Bette Kleinschmidt-DeMasters, MD; Nicholas Foreman, MD; Andrew Donson, BS; Michael Handler, MD, FACS (Denver, CO)

70. Differentiating Brain Tumor Progression from Pseudoprogression in Children Using Ferumoxytol, A Novel Magnetic Resonance Imaging Contrast Agent
Daniel J. Guillaume, MD, MSc; Eric Thompson, MD; Edit Dosa, MD; Kellie Nazemi, MD; Edward E. Neuwelt, MD (Portland, OR)

71. Intracranial Tumours in Infants: Long Term Quality of Life and its Predictors
Mary Metrie, BS; Shibu Pillai, MD; Paul Steinbok, MD, FRCS; Doug Cochrane, MD, FRCS; Ashutosh Singhal, MD, FRCS; Juliette Hukin, MD; Michael Sargent, MD; Christopher Dunham, MD (Canada, Vancouver)

72. Neoadjuvant Chemotherapy Reduces Vascularity and Permits Safe Resection in Infantile Vascular Neoplasms
Mark Van Poppel, MD; Paul Klimo, MD; Mariko Dewire, MD; Karen Wright, MD; Thomas Merchant, MD; David Ellison, MD; Robert Sanford, MD; Amar Gajjar, MD; Frederick Boop, MD (Memphis, TN)

73. The Management of Spinal Aneurysmal Bone Cysts
Georgios A. Zenonos, MD; Lance Governale, MD; Osama Jamil, MD; Sarah Jernigan, MD; Mark Proctor, MD (Boston, MA)

74. Proteomic Analysis of Cerebral Spinal Fluid from Children with Brainstem Glioma
Amanda L. Muhs, MD; Suresh Magge, MD; Javad Nazarian, PhD (Washington, DC)

9:50 – 10:00 AM
Franc Ingraham Award for Distinguished Service and Achievement
Awardee: Robert A. Sanford, MD

10:00 - 10:20 AM
Beverage Break in Exhibit Hall
Award Reception for Robert A. Sanford, MD

10:20 - 10:50 AM
Neuromonitoring
Daniel M. Schwartz, PhD

10:50 AM - 12:00 PM
Scientific Session X: Functional Disorders
Moderators: David M. Frim, MD, FACS, Mark G. Luciano, MD, PhD

75. Selective Dorsal Rhizotomy: Somatotopic Organization of Sensory Nerve Rootlets
Victor L. Perry, MD; Crystal Adams (Chapel Hill, NC)

76. Deep Brain Stimulation (DBS) for Childhood Dystonia with the Frameless Stereotactic System: Operative Experience and Accuracy
Daniel Curry, MD; Akash Patel, MD; Amber Stocco, MD; Aloysia Schwabe, MD; Robert Dauser, MD; Andrew Jea, MD; William Whitehead, MD; Thomas Luerssen, MD; Daniel Curry, MD (Houston, TX)

77. Surgical Treatment of Pediatric Trigeminal Neuralgia with Microvascular Decompression
Bender Matthew, BA; Gustavo Pradilla, MD; Carol James, PA-C; Shaan Raza, MD; Michael Lim, MD; Benjamin S. Carson, MD (Baltimore, MD)

78. Amenorrhea Complicating Endoscopic Third Ventriculostomy in Children: Case Report and Review of the Literature
Steven W. Hwang, MD; William E. Whitehead, MD; Daniel J. Curry, MD; Thomas G. Luerssen, MD; Andrew Jea, MD (Houston, TX)

79. Fenestration of Lumbar Thecal Sac Can Prevent the Need for Ventriculoperitoneal Shunting in Post-Operative Pediatric Patients
Kurtis I. Auguste, MD (San Francisco, CA); Susan Ditmyer, NP; Peter P. Sun, MD (Oakland, CA)

80. Therapeutic Target B7-H3 is Expressed in Pediatric Diffuse Intrinsic Pontine Glioma
Zhiping Zhou, MD, PhD; Neal Luther, MD (New York, NY); Rajeev Vibhakar, MD, PhD; Michael H. Handler, MD (Denver, CO); Nai-Kong V. Cheung,MD, PhD, (New York, NY); Cynthia Hawkins, MD, PhD, (Toronto, ON, Canada); Mark M. Souweidane, MD (New York, NY)

81. Acquired Chiari I Malformation of Infancy
James E. Messegee, BS; Alan Cohen, MD; Shenandoah Robinson, MD, (Cleveland, OH)

12:00 PM
Closing Remarks
Ann-Christine Duhaime, MD

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Ricky Wong, MD
Robin Yang, DDS
Georgios Zenonos, MD
Zhiping Zhou, MD, PhD

ORAL ABSTRACTS

1. **A Method to Explain the Variation in Reported ETV Success Among Published Case Series of Childhood Hydrocephalus**
Abhaya V. Kulkarni (Toronto, Canada); Jay Riva-Cambrin, MD, MSc (Salt Lake City, UT); Samuel R. Browd, MD, PhD (Seattle, WA)
Introduction: Published case series of endoscopic third ventriculostomy (ETV) for childhood hydrocephalus have reported widely varying success rates. We recently developed the ETV Success Score (ETVSS) - a simplified means of predicting the success rate of ETV, based on age, etiology of hydrocephalus, and presence of a previous shunt. We hypothesized that the ETVSS would be able to predict the actual ETV success rate reported among published case series.
Methods: A literature search identified pediatric ETV papers that contained enough information to calculate a predicted ETVSS for the cohort. This was compared to the actual ETV success rate of the cohort. Data was extracted independently in triplicate.
Results: We identified 15 papers (322 patients) with reported ETV success ranging from 31.3% to 92.3%. Among the 3 raters, the inter-rater reliability was high for scoring study ETVSS (ICC=0.99) and study ETV success (ICC=0.95). The predicted ETVSS for each paper agreed strongly with the actual ETV success rate reported by each paper (reliability=0.81). In a linear regression model, the predicted ETVSS explained 62% of the variation in actual ETV success. When the 322 patients were analyzed together, the overall mean predicted ETVSS was 57.9% - nearly identical to the actual ETV success rate of 59.2%.
Conclusions: The ETVSS has excellent inter-rater reliability and generalizability. It closely predicts the actual ETV success reported in selected papers published over the last 20 years. This suggests that most of the variation in reported ETV success is due to differences in patient selection, not technical factors.

2. **Effects of Early and Late Reservoir Treatment in Experimental Neonatal Hydrocephalus**
Ramin Eskandari, MD, MS; Osama Abdullah, BS; Eric C. Burdett, DVM; Chase Bryan; Kristina Carlson, BS; Kelley Deren, MS; Melissa Packer, BS; Edward W. Hsu, PhD; Pat McAllister, PhD (Salt Lake City, UT)
Introduction: Delayed neurosurgical intervention is common in premature neonates with hydrocephalus but no outcome data exist on when ventricular reservoirs should be placed.
Methods: Obstructive hydrocephalus was induced in 10-15 day old felines by intracisternal injection of 25% kaolin with saline controls. Reservoirs were placed at 7-8 (early) or 15-16 (late) days post-kaolin; all animals survived 12 weeks post-injection. A clinically relevant 14-point neurological defect scoring system determined symptomatic CSF tapping (score >2). Ventriculomegaly and white matter integrity were evaluated with 7T MRI (T2 and diffusion tensor imaging, DTI). Motor/dexterity testing was performed at 12 weeks post-injection.
Results: Ventriculomegaly in the early group was moderate with none/minimal neurological deficits (scoring range 1.15-1.49 for the entire post-reservoir period) and severe with multiple deficits (2.14-3.39) in the late group. Dexterity scores revealed progressive impairments relative to the severity of ventriculomegaly. DTI indicated structural alterations in corpus callosum(CC), internal and external capsules(IC/EC) and periventricular white matter. FA decreased 25-50% in CC and EC within 1wk post-kaolin and was sustained for 3wks after early treatment. Late treatment DTI results are pending.
Conclusions: Preliminary data suggest associations between severity of ventriculomegaly and neurological/motor performance, and structural deterioration of white matter tracts quantified radiographically. To our knowledge this is the first study to assess chronic hydrocephalic animals in multiple modalities treated with ventricular reservoirs at two different time points with the goal of differentiating the benefits or early versus late treatment. Ongoing analysis including histopathology, CSF-biomarkers and additional neurological data will further elucidate these benefits.

3. **Effectiveness of Endoscopic Third Ventriculostomy and Ventriculoperitoneal Shunt Placement in the Treatment of Hydrocephalus**
Sarah Jernigan, MD, MPH; Dionne Graham, PhD; Jay Berry, MD; Liliana Goumnerova, MD (Boston, MA)
Introduction: The study objective is to compare the effectiveness of cerebrospinal fluid (CSF) diversion with endoscopic third ventriculostomy (ETV) and ventriculoperitoneal shunt placement (VPS) in infants with hydrocephalus.
Methods: A retrospective analysis of 6,370 infants = 1year of age with hydrocephalus who underwent CSF diversion with ETV or VPS at 41 children's hospitals between 2004 and 2008. Data were obtained from the Pediatric Health Information Systems database. Surgical failure was defined as the need for a repeat operation within one year of initial surgery. We compared failure rates by ETV and VPS, patient demographics and clinical characteristics with chi-square and logistic regression.
Results: 1,567 (25.6%) infants underwent ETV and 4,803 (74.4%) underwent VPS initially. The median initial infant age was 37 days (IQR 11-122 d) for both ETV and VPS. More infants who underwent ETV were premature (41.6% vs. 23.9%, p <.01) and had IVH (45.4% vs. 17.5%, p<.01) compared with VPS. More infants with myelomeningocele (24.3% vs. 7.9%, p<.01) underwent VPS compared with ETV. Infants undergoing ETV experienced higher failure rates at one year [67.1% vs. 39.7%, Odds Ratio 3.1 (95% CI 2.7,3.5) p<.01] compared with VPS. In multivariate analysis, ETV remained associated with higher failure [Odds Ratio 2.8 (95% CI, 2.5,3.2)] after controlling for prematurity, intraventricular hemorrhage, and myelomeningocele.
Conclusions: Infants with hydrocephalus may be experience greater one-year CSF diversion success with VPS compared with ETV. Further investigation of the need for multiple re-operations, cost, and impact of surgeon and hospital experience is necessary to distinguish which treatment is more effective long-term.

4. **Ventriculocystocisternostomy is an Effective Treatment for Suprasellar Arachnoid Cysts**
Cormac O. Maher, MD (Ann Arbor, MI); Liliana Goumnerova, MD (Boston, MA)
Introduction: We report on the long-term outcomes of endoscopic ventriculocystocisternostomy (VCC) for suprasellar arachnoid cysts and analyze all published reports on outcomes of ventriculocystostomy (VC) versus VCC in order to compare the effectiveness of the two techniques.
Methods: 11 consecutive patients with previously untreated suprasellar arachnoid cysts were surgically treated with endoscopic VCC. 2 additional patients were treated with VCC following ventriculoperitoneal shunt. Clinical imaging data were recorded. A meta-analysis of all published patient outcomes following endoscopic VC or VCC for a suprasellar arachnoid cyst was performed.
Results: Developmental delay and progressive macrocephaly were the most common preoperative symptoms. At a mean clinical follow-up interval of 63 months, 10 of 11 patients undergoing primary VCC have not required re-operation. A meta-analysis of the literature suggests that VCC may be more effective than VC. 7 of 44 (16%) reported patients that underwent VC as a first treatment required re-operation and 7 of 86 (8%) of patients that underwent VCC as a first treatment required re-operation. When VC or VCC was carried out following a prior surgical procedure, 4 of 11 patients undergoing VC had a treatment failure requiring re-operation. In contrast, only 2 of the 17 reported cases of VCC following a prior procedure required further treatment. The difference in re-operation rates following either primary or secondary VC was significantly higher than following primary or secondary VCC (p=0.04).
Conclusions: We conclude that VCC is an effective and durable treatment for symptomatic suprasellar arachnoid cysts in most cases.

ORAL ABSTRACTS

5. **Third Ventricular Shape: A Predictor of Endoscopic Third Ventriculostomy Success**

Mansoor Foroughi, MBBS, FRCS; David D. Cochrane, MD, FRCS; Andrew Wong, BSC; Paul Steinbok, MBBS, FRCS; Ash Singhal, MD, FRCS; Michael Sargent, MD, FRCS (Canada, Vancouver)

Introduction: The criteria for identifying patients in whom endoscopic third ventriculostomy (ETV) provides control of hydrocephalus remain in evolution. The authors postulated that 1) displacement of the third ventricle floor (3VF) inferiorly of the third ventricle into interpeduncular cistern and of the lamina terminalis (LT) anteriorly into the interhemispheric cistern could predict clinical success of ETV and 2) improvement in these displacements would correlate with success of ETV.

Methods: MR imaging of 31 consecutive patients treated between 2004 and 2010 was reviewed to assess displacement of the LT and 3VF prior to and following ETV. Displacements of the floor and LT were judged qualitatively and quantitatively, using a newly created index, the Vancouver Third Ventricular Index (VTVI). The association between these morphological features and clinical success of ETV was analyze.

Results: Ninety-five percent of patients who had successful ETVs exhibited displacement of the LT and the third ventricular floor pre-operatively. Displacements of the 3VF and LT, as judged qualitatively, correlated with clinical success of ETV. The VTVI correlated with the qualitative assessments of displacement. Post operative decrease in the VTVI occurred in all successfully treated patients. Changes in third ventricular morphology preceded changes in measures of third and lateral ventricular volume following ETV.

Conclusions: Assessment of 3VF and LT morphology is useful in predicting clinical success of ETV and in the follow up of patients so treated. The VTVI provides a quantitative assessment of the 3rd ventricular morphology, which may be useful in equivocal cases and in research studies.

6. **Assessing Premature Infants for Findings of Increased Intracranial Pressure: An HCRN Inter-Rater Reliability Study**

John C. Wellons III, MD (Birmingham, AL); Jay Riva-Cambrin, MD, MSc (Salt Lake City, UT); William Whitehead, MD, MPH (Houston, TX); Samuel Browd, MD, PhD (Seattle, WA); John Kestle, MD, MSc (Salt Lake City, UT); Abhaya Kulkarni, MD, PhD (Toronto, Canada)

Introduction: Previous studies from our Hydrocephalus Clinical Research Network (HCRN) have shown a great degree of variation in surgical decision making for infants with post-hemorrhagic hydrocephalus, i.e. when to temporize, when to shunt, or when to convert. Since much of this clinical decision-making is dictated by clinical signs of increased intracranial pressure (including bulging fontanel and splitting of sutures), we investigated whether there was variability in how these signs were being assessed by neurosurgeons. We wanted to answer the question: is there acceptable inter-rater reliability in the neurosurgical assessment of bulging fontanel and split sutures?

Methods: Explicit written definitions of "bulging fontanel" and "split sutures" were agreed upon with consensus across the HCRN. At 3 HCRN centers, pairs of neurosurgeons independently assessed premature infants in the first 3 months of life for split sutures and bulging fontanels, according to the a priori definitions. Inter-rater reliability was then calculated between pairs of observers using intra-class correlation coefficient (ICC). IRB approval was obtained at each center.

Results: In the assessment of 26 infants (52 independent observations), the inter-rater reliability (ICC, 95% confidence interval) was 0.92 (0.82-0.96) for split sutures and 0.73 (0.49-0.87) for bulging fontanel. No complications from the study were encountered.

Conclusions: We have found a high degree of inter-rater reliability among neurosurgeons in their assessment of bulging fontanel and split sutures. While decision-making may vary, the clinical assessment of this cohort appears to be consistent among physicians.

7. **Malfunction Rates in Antibiotic-Impregnated Versus Non-Antibiotic-Impregnated Proximal CSF Shunt Catheters**

Naina L. Gross, MD; Ryan Rahhal, MD (Oklahoma City, OK)

Introduction: Malfunction rates in Antibiotic-Impregnated vs. Non-Antibiotic-Impregnated Proximal CSF Shunt Catheters

Introduction: Antibiotic-impregnated catheters (AICs) have been shown to potentially reduce shunt infections. The incidence of proximal shunt malfunction in these catheters has not been studied. Because the antibiotic-impregnated catheters (AIC) have a smaller inner diameter and different hole configuration, there has been concern over whether these catheters malfunction more often.

Methods: A retrospective chart review was completed. Patients receiving CSF shunt procedures during a three-year period were identified. We identified 116 patients who received shunts within the first year of life. Shunts were placed for hydrocephalus associated with spina bifida, intraventricular hemorrhage, or congenital causes. Patients that had subsequent revisions for proximal malfunction were also identified.

Results: In the 116 patients, 50 revisions have been done for proximal malfunction. This number was added to the 116 for a total of 166 eligible proximal catheters. Of the 166 eligible catheters, a total of 106 AICs were placed and 60 non-impregnated catheters were placed. The total number of proximal revisions within the same set of patients in the same time period was 50. Of the 50 proximal obstructions, 32 were done for AICs and18 were done for non-impregnated catheters. The overall rate of malfunction for proximal AICs was 30.19%. The overall rate of malfunction for non-impregnated proximal catheters was 30.0%. (No statistical difference).

Conclusion: Proximal AICs were no more likely to develop proximal malfunctions requiring operative revision than non-antibiotic-impregnated proximal catheters.

8. **Efficacy and Safety of Ultrasound Guided Shunt Insertion**

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Introduction: Shunt survival may improve when ventricular catheters are placed into the frontal horn or trigone and away from the choroid plexus. Our objective is to identify a technique that results in accurate catheter placement (>80% of cases). We evaluated the efficacy of ultrasound guided catheter insertion at 4 HCRN centers.

Methods: This was a prospective, blinded, controlled trial. All surgeons targeted the frontal horn or trigone for ventricular catheter placement. Eleven surgeons used only intraoperative ultrasound to place the ventricular catheter; six surgeons used only conventional shunt insertion techniques. All patients were pediatric without previous shunt insertion. A blinded neuroradiologist evaluated catheter placement.

Results: In the ultrasound guided group, 40 of 68 catheters were placed accurately into the frontal horn or trigone (59%; 95% CI 46%, 71%); and 25, 1, and 2 were placed into the body, third ventricle, and brain, respectively (1 catheter was undeterminable). In the conventional surgery group, 25 of 49 catheters were placed accurately (51%; 95% CI 36%, 66%); and 10, 2, and 12 were placed into the body, third ventricle, and brain, respectively (3 patients have not been imaged).

Conclusions: Ultrasound guided shunt insertion did not result in accurate catheter placement. Other factors must affect ventricular catheter placement which are not corrected for with intraoperative ultrasound guidance. Ultrasound guidance seems to result in a significantly lower rate of ventricular catheters embedded in the brain and this may have an effect on shunt survival; shunt survival curves will be reported when the data matures.

9. Outcomes of Modern Endovascular Treatment of Vein of Galen Malformations

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Introduction: Vein of Galen aneurismal malformations (VGAM) if untreated carry almost 100% morbidity and mortality. We report the outcome of modern endovascular therapy in a consecutive series of 56 patients with VGAM.

Methods: A consecutive series of 56 children presented with VGAM from June of 2004 to December of 2009. All were treated by transarterial liquid embolization with cyanoacrylate tissue adhesive (NBCA) as the primary agent; targeting the fistula sites via percutaneous femoral artery access. Coils were only used to rearrange the anatomy or protect normal arteries. Nine neonates were treated due to failed medical management of their heart failure and then all underwent staged embolizations to obtain closure of the malformation. A total of 225 procedures were done.

Results: Total obliteration was achieved in 16/56 (28.5%). Near total obliteration (>90%) was achieved in 13/56 (23.2%). Significant malformation remained open in 7/56 (12.5%) who received targeted embolizations and 20/56 (35.7%) are still undergoing treatment. Twelve complications occurred in the 225 procedures. Seven were technical with no clinical manifestations. There were 3/56 deaths: 2 from hemorrhage (3.7%) and 1 from CHF, and 2/56 infarctions (3.7%) with residual clinical consequences.

Conclusions: Treatment of VGAM with modern endovascular techniques in conjunction with specialized pediatric neuroanesthetic and neurointensive care results in significantly improved outcomes with cure and normal neurological development. Multiple stages are often necessary. These patients require care by an interdisciplinary team in specialized centers devoted to this group of diseases.

10. An Assessment of Concurrent Aneurysms in the Presentation and Treatment of Pediatric Brain Arteriovenous Malformations

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Introduction: The concurrent presentation of AVMs and intracranial aneurysms in children poses unique challenges to pediatric neurosurgeons due to the relative lack of data available. In this retrospective cohort study, we sought to determine any differences in the incidence of hemorrhage, clinical presentation, or neurological outcomes in children with AVMs relative to children with AVMs and associated aneurysms.

Methods: Seventy-seven pediatric patients (<22 years old) with AVMs were treated at CUMC between 1991 and 2010. Twenty-two patients (29%) had AVM-associated aneurysms. The records and imaging studies of each patient were reviewed, and the groups were compared regarding incidence of hemorrhage, severity of disability on presentation using the modified Rankin Score (mRS), and the mRS on the most recent follow up after treatment. Mann-Whitney and chi-squared testing was used.

Results: Thirty-five of the 55 patients (64%) with only AVMs presented with hemorrhage, while 13 of 22 patients (59%) with both AVMs and aneurysms presented with hemorrhage. In patients with concurrent aneurysms and hemorrhage, the average mRS was 2.54 on presentation and 1.15 on most recent follow up, whereas patients with hemorrhage but no aneurysms scored an average of 2.00 and 0.64 respectively. Neither subgroup had a higher association with hemorrhage (p=0.71) or worse mRS (p=0.328) at presentation or at most recent follow up (p=0.784).

Conclusion: These results suggest that the presence of concurrent aneurysms in children with AVMs does not appear to significantly alter the incidence of hemorrhage, clinical presentation, or clinical outcome when compared to children with AVMs without aneurysms.

11. Intracranial Aneurysms in Childhood

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Introduction: To characterize the clinical, imaging, treatment, and outcome associated with children diagnosed with intracranial aneurysms at a single tertiary care institution.

Methods: Retrospective evaluation of medical records, MRI scans, and intracranial angiogram from all pediatric patients at a university hospital over the last 27 years.

Results: Between 1981 and 2008, 77 patients (mean age=12 years, 40 female, 37 male) presented with 103 intracranial aneurysms. Patients reported headache (45%), cranial neuropathies (16%), nausea/vomitting (15%), vision changes (13%), trauma (13%), seizure (4%), or sensory changes (3%). Of 103 total aneurysms, 11% measured greater than 25 mm. Aneurysm types included 31 fusiform aneurysms in 25 patients, 47 saccular aneurysms in 35 patients, 12 infectious aneurysms in 6 patients, and 15 traumatic aneurysms in 12 patients. Subarachnoid hemorrage occured in 25 patients. A total of 60 patients underwent treatment of their aneurysms; 18 patients were managed conservatively with close follow-up and serial imaging. Nineteen patients underwent primary endovascular coiling, one patient had endovascular stent-coiling, 11 patients received endovascular balloon/coil parent artery occlusion, 19 patients underwent surgical clipping, and 10 patients had aneurysms trapped and bypassed. Overall mortality was 1.3%. Morbidity included 5% infarction and 1.3% new onset seizure disorder. Six patients developed new aneurysms or had enlargement of untreated aneurysms during the follow up period.

Conclusions: Intracranial aneurysms in children differ in distribution and etiology as compared to those in adults. Complex aneurysm morphologies, underlying vasculopathies, and the long expected lifespans of patients warrant a comprehensive multidisciplinary approach to both acute and chronic management of aneurysmal disease in children.

12. Intraoperative Angiography During Microsurgical Resection of Arteriovenous Malformations in Children

Michael J. Ellis, MD; Abhaya Kulkarni, MD, FRCS; James Drake, MD, MSc; James Rutka, MD, PhD; Derek Armstrong, MD; Peter Dirks, MD, PhD (Toronto, Canada)

Introduction: Confirmation of successful management of pediatric arteriovenous malformations (AVMs) requires high-quality post-operative digital subtraction angiography. Although the role of intra-operative angiography during microsurgical resection of AVMs is well established in adults, few studies have evaluated the efficacy and safety of this technique in children. We report our experience with intraoperative angiography during the surgical management of pediatric AVMs in our image-guided therapy (IGT) facility.

Methods: We retrospectively reviewed the clinical and radiologic characteristics of all patients who underwent surgical management of an AVM at Hospital for Sick Children, Toronto, ON with the aid of intra-operative angiography via a transfemoral approach.

Results: 18 children underwent surgical management of an AVM with intra-operative cerebral angiography in our IGT facility. 4 additional children underwent immediate post-operative angiography after surgery in the regular operating room. Mean AVM size was 2.55cm with a mean Spetzler-Martin grade of 2.27. Intra-operative angiography in 5/22 patients demonstrated residual AVM requiring additional surgical resection. Complications occurred in 1/30 angiograms. Negative intra-operative angiograms were confirmed with follow-up angiograms in 15/16 patients at a mean of 9.93 months. One patient with a negative intra-operative angiogram demonstrated residual AVM (false-negative rate= 6.25%) on follow-up angiography at 8 months, but had a negative pre-operative angiogram 1 year later. No patient with a negative intra-operative angiogram required further AVM-directed treatment.

Conclusions: Intra-operative angiography is a safe and effective adjunct to the surgical management of AVMs in children. This novel approach can help guide the resection of residual AVMs, especially those of a diffuse or complex angioarchitecture.

ORAL ABSTRACTS

13. Multimodality Therapy of Pediatric Intracranial Arteriovenous Malformations

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Introduction: Successful management of pediatric arteriovenous malformations (AVMs) often requires a balanced application of embolization, surgery, and radiosurgery. The authors describe their experience treating pediatric AVMs.

Methods: We analyzed 120 pediatric (<18 years) AVMs treated with various combinations of radiosurgery, surgery, and endovascular techniques.

Results: Between 1985-2009, 76 children with low Spetzler-Martin grade (I-III) and 44 with high-grade (IV-V) AVMs were treated. Annual risk of hemorrhage from presentation to initial treatment was 4.0%, decreasing to 3.2% after treatment initiation until confirmed obliteration. AVM obliteration results were available in 101 patients. Initial single-modality therapy led to AVM obliteration in 51/67 (76%) low-grade and 3/34 (9%) high-grade AVMs, improving to 58/67 (87%) and 9/34 (26%) respectively with further treatment. Mean time to obliteration was 1.8 years for low-grade and 6.4 years for high-grade AVMs. Disabling neurological complications occurred in 4/77 (5%) low-grade and 12/43 (28%) high-grade AVMs. At final clinical follow-up (mean 9.2 yrs), 48/67 (72%) with low-grade lesions had mRS 0-1, compared to 12/34 (35%) for high-grade AVMs. On multivariate analysis, significant risk factors for poor final clinical outcome (mRS =2) included baseline mRS =2 (OR 9.51 [95% CI: 3.31, 27.37] P<0.01), left-sided location (OR 3.03 [95% CI: 0.12, 0.90] P=0.04), and high AVM grade (OR 4.35 [95% CI: 1.28, 14.28] P=0.02).

Conclusions: Treatment of pediatric AVMs with multimodality therapy can substantially improve obliteration rates and may decrease AVM hemorrhage rates. The poor natural history and the risks of intervention must be carefully considered when deciding to treat high-grade pediatric AVMs.

14. Surgical Management of the Symptomatic, Enlarging, Isolated Fourth Ventricle

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Introduction: A symptomatic, enlarging, isolated fourth ventricle is a difficult problem to surgically manage & is usually associated with multiple co-variables. Although each clinical scenario is unique, we reviewed our institutional series to see what strategies were more effective.

Methods: Under IRB approval, a retrospective analysis was undertaken of patients who met the above criteria during the last decade

Results: A total of 30 patients were treated. Underlying abnormalities included 18 preterm infants with Grade III-IV intraventricular germinal matrix hemorrhage, 5 with posterior fossa tumors, 4 cases of congenital Dandy-Walker malformation with late presentation, 1 with congenital hydrocephalus & 1 each secondary to meningitis & cerebellar hemorrhage. Primary operative procedures were: Shunting - 16/30 patients, open microscopic fenestration- 12/30 & Endoscopic fenestration- 2/30. Patients not requiring additional procedures were: shunting- 3/16, open microscopic fenestration- 5/12 & Endoscopic fenestration 1/2. A total of 149 procedures have been done with a median follow up of 5 years. There were 15 incidences of CSF infections in 96 shunt related procedures while there were no instances of CSF infection in those patients with no hardware. During 5 open fenestrations, all encountered choroid plexi were excised & none have required another procedure. No new neurological deficits arose from the fenestration procedures

Conclusions: These patients often require multiple procedures using a variety of operative approaches and techniques. Excision of any encountered choroid plexus is recommended as it may help to decrease CSF formation in the area of involvement. Omitting hardware can significantly reduce the incidence of CSF infection.

15. Variations in the Neurosurgical Care of Premature Infants with Intraventricular Hemorrhage: A Multicenter Study

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Introduction: There is little consensus amongst both neurosurgeons and neonatologists regarding which and when premature neonates with IVH and hydrocephalus should undergo a temporization procedure (reservoir or subgaleal shunt). The goal of this study was to describe this variation and determine the factors influencing the neurosurgical decisions.

Methods: A consecutive sample of the last 25-32 patients surgically treated for IVH related to prematurity was collected from the four clinical centers of the HCRN; totaling 110 neonates. Two outcomes were examined: the utilization of a temporization procedure or not and whether or not these were converted to permanent shunts. Clinical, radiological, and processes of care factors were analyzed in univariate and multivariate fashions.

Results: Of the 110 neonates, 73 (66%) underwent temporization procedures- 50 ventricular reservoirs and 23 subgaleal shunts. Center (p<0.001), along with increasing ventricular size (p=0.035), were significantly associated with the utilization of a temporization procedure; whereas clot characteristics, OFCs, and fontanelle assessments were not. Permanent shunts were placed in 101/110 (92%) neonates. A full fontanelle (p<0.001), increased ventricular size (p=0.001), and a trend for the absence of residual clot (p=0.06) were associated with conversion of the temporization devices to permanent shunts; whereas center and OFCs were not.

Conclusions: There is considerable center variability in terms of whether and what types of temporization procedures are used. This variation between centers in neurosurgical decision-making is not seen with permanent shunting. It appears that increasing ventricular size rather than clinical findings such as rising OFCs are more representative of the threshold to either temporize or shunt.

16. Post-Hemorrhagic Hydrocephalus in Neonatal Mice: High Resolution In-Vivo Magnetic Resonance Imaging and Histology

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Introduction: Post-hemorrhagic hydrocephalus (PHH) is a common cause of severe white matter injury and neurologic disability in children with extreme prematurity. While small animal models of PHH have been reported, it is desirable to have a quantitative in-vivo monitoring tool for evaluation of potential therapeutics. The objective of this study was to employ in-vivo magnetic resonance imaging (MRI) as a detection method for hydrocephalus after cisternal blood injection in neonatal mice.

Methods: All studies were approved by the institutional animal care and use committee. Cisternal blood injections were performed in CD-1 mouse pups on PND 3. 9-l of blood was injected into the cistern magna. High resolution T2 weighted MRI was performed on PND 15 and mice were euthanized by perfusion-fixation.

Results: The survival rate of the blood injection procedure was 77%. The imaging demonstrated visible ventriculomegaly in 36/57 (63%) of blood-injected animals. 5 of these animals (14%) developed massive hydrocephalus with severe enlargement of all ventricles and significant thinning of periventricular and cortical tissue. In comparison, 6/16 (38%) of saline-injected animals developed visible ventriculomegaly. Volumetric analysis showed a significantly higher ventricular volume in the blood-injected animals compared to non-injected controls. Histological studies showed thinning of corpus callosum adjacent to the enlarged ventricle with reactive astrocytosis and increased activated caspase3 staining.

Conclusion: We present a mouse model for PHH of prematurity with the use of MRI as a quantitative monitoring tool and with immunohistochemical evidence of white matter damage in the immature brain. The model is a potential test bed for novel therapeutics.

17. Risk of Shunt Failure Related to Cerebrospinal Fluid Parameters in Premature Infants with Post-Hemorrhagic Hydrocephalus

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Introduction: Premature, low-birth weight infants with post-hemorrhagic hydrocephalus (PHH) are at high risk of shunt obstruction and infection. There is anecdotal concern that the amount of red blood cells or protein levels in the cerebrospinal fluid (CSF) affects shunt survivability. However, this has not been analyzed specifically for these high-risk patients.

Methods: A retrospective cohort study was performed on premature, low-birth weight (< 1500 gram) infants shunted for PHH from 2000-2010 at Riley Hospital for Children. Data points included the gestational age at birth and shunt insertion, weight at birth and shunt insertion, shunt failure, shunt infection, prior CNS infection, and the CSF levels of red blood cells and protein. All patients had CSF analyzed within two weeks prior to insertion of the shunt. Statistical analysis was performed to look for any association between shunt outcome and the CSF parameters.

Results: Fifty-eight patients were identified for analysis. Ten patients (17.2%) had primary shunt obstruction within three months of insertion. Nine patients (15.5%) had shunt infection within three months. There was no statistical relationship of shunt malfunction or infection to the pre-shunt levels of red blood cells or protein in the CSF.

Conclusions: Low birth weight, premature infants with post-hemorrhagic hydrocephalus have a high rate of shunt obstruction and infection. We did not find any statistical association of shunt obstruction or infection to CSF cell count or protein.

18. Quality of Life Changes Following Pediatric Epilepsy Surgery

Amy Lee, MD; Jeffrey Titus, PhD; David Limbrick, MD, PhD; Liulin Thio, MD; Jennifer Rogier, BA; Matthew Smyth, MD (Saint Louis, MO)

Introduction: Quality of life (QOL) is an important outcome variable in pediatric epilepsy surgery, but there is limited information about the effect of surgery on QOL. Though recent studies have focused exclusively on post-surgical QOL, our investigation compares changes in pre- and post-surgical parental QOL ratings.

Methods: Twenty-eight children who underwent epilepsy surgery between 2006 and 2009, who had pre- and post-surgical neuropsychological testing were selected. Data was compiled using parental ratings on the Quality of Life in Childhood Epilepsy (QOLCE) questionnaire. Post-operative cognitive changes were measured using the Wechsler Abbreviated Scale of Intelligence. Pre- and post-surgical changes were analyzed with paired t-tests or Wilcoxon's signed rank test.

Results: All pediatric patients, female (56%) and male (54%), had a mean age at the time of surgery of 12.7 years (SD=2.6). Mean follow-up time was one year. While intelligence scores were stable (p=0.74), parent reports on the QOLCE revealed significant improvements in Total QOL (p=0.002), subjective improvements in QOL (p=0.01), general health (p<0.0001), behavior (p=0.004), physical activities (p=0.01), and social activities (p=0.004). There were no statistically significant changes in QOL related to cognition (p=0.06) and general well-being (p=0.11).

Conclusions: These results reveal significant improvement in the QOL of children following epilepsy surgery, with no change in intellectual function or cognitive functions. Nevertheless, improvements in QOL are evident in many realms, including QOL, general health, behavior, and physical and social activities.

19. Perioperative Seizure Incidence and Risk Factors in 223 Pediatric Brain Tumor Patients without Prior Seizures

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Introduction: The incidence of and risk factors for perioperative seizures and the need for perioperative anti-epileptics (AEDs) in previously seizure-free children with brain tumors remain unclear. Our Department does not routinely use prophylactic AEDs, so our patients provide an excellent study population.

Methods: Retrospective review of all patients age 0-19 years without prior seizures undergoing craniotomy for tumor resection at our institution between January 2005 and December 2009. Any clinical event suspicious for seizure during surgical hospitalization was considered a perioperative seizure.

Results: 223 patients undergoing 229 operations were identified; 51% of all tumors were supratentorial. Only 4.4% of patients received prophylactic AEDs. 7.4% of patients had at least one perioperative seizure. Patients with perioperative seizures were more likely to have supratentorial tumors (88% vs. 48%, p = 0.002), be under two years of age (59% vs. 9.4%, p < 0.001), and have hyponatremia due to SIADH or CSW (53% vs. 8.5%, p < 0.001) than patients who remained seizure-free during the surgical admission. Gender, preoperative hydrocephalus, tumor pathology or size, lobe affected, operative blood loss, and length of surgery were not independently associated with seizures. Perioperative seizure incidence in patients over age two without hyponatremia was only 1.7%.

Conclusion: Perioperative seizures in previously seizure-free children undergoing surgical resection of brain tumors are associated with supratentorial location, young age, and hyponatremia. We recommend that pediatric tumor patients over age two not routinely receive perioperative prophylactic AEDs, although the role of prophylaxis in patients under age two deserves further investigation.

20. Functional MRI and Tractography of Visual Pathways for Pre-Surgical Planning in Sedated and Awake Children

Frederick A. Boop, MD; Robert Ogg, PhD, MD; Matthew Scoggins, PhD; Stephanie Einhaus, MD; Paul Klimo, MD, MPH; Mason Shifflet, MD; James A. Wheless, MD (Memphis, TN)

Introduction: Functional MRI (fMRI) has allowed pre-surgical planning to avoid critical neural structures in brain surgery. Most fMRI series are limited to cooperative older patients. The authors report a retrospective series of children in whom fMRI and tractography identified visual pathways, often in young, uncooperative patients. The technique and case examples will be presented in which vision was spared using this information for surgical guidance.

Methods: Between 2007 -2010, 37 children ranging in age from 3 months to 17 years were studied by visual stimulation and fMRI recording of blood oxygen level dependent (BOLD) signal. Eleven were studied under propofol sedation. 33/37 had intractable epilepsy. Thirteen had tumors. Five had cortical dysplasia.

Results: In each case primary visual cortex could be identified by fMRI. In those undergoing resections, these data were then co-registered to the frameless stereotactic system to design a surgical approach which might spare vision. No complications were noted related to the fMRI technique.

Conclusions: fMRI to map visual pathways can be performed safely in young and uncooperative patients even under conscious sedation. This information can be used to guide the surgical approach and spare vision. Case examples and results will be presented.

ORAL ABSTRACTS

21. Surgical Treatment of Refractory Status Epilepticus in Children

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

Introduction: Refractory status epilepticus (RSE), defined as status epilepticus is a life-threatening condition. Neurosurgical treatment is an option for some of these patients. We report our experience with surgery on patients with RSE.

Methods: Retrospective chart review of the epilepsy surgery database of The Brain Institute of Miami Children's Hospital, Miami, FL, USA, from 1996 to 2010.

Results: Of the 650 children operated for epilepsy surgery in our hospital, there were 13 (8 boys, 5 girls) who were operated on a semi-emergent basis after having failed aggressive medical treatment in the pediatric intensive care unit for two weeks. The mean age at presentation was 10.2 years (range 2 to 19 years). Nine patients had cortical dysplasia (CD) as seizure etiology; others either had Rasmusssen's encephalitis, history of encephalitis in the past or old infarction. Ten patients underwent tailored resection and two had multiple subpial transections. One patient had hemimegalencephaly and underwent hemispherectomy. Post-operatively, three patients had hemiparesis, all of whom have significantly improved. There was no mortality, wound infection, meningitis, hematoma, or hydrocephalus requiring shunting. RSE stopped acutely in all patients. Follow up ranged from 3 months to 5 years. Overall, six patients are seizure free and four have more than 90% reduction in seizures. Three patients have 50% or less reduction in seizures.

Conclusion: Both resective and disconnective surgeries appear to be effective in controlling seizures in selected patients with RSE. Neurosurgical treatment should be considered early in the course of RSE.

22. Vagus Nerve Stimulation for Children with Medically-Intractable Epilepsy: A Consecutive Series of 141 Children 18 Years of Age or Less

Luigi Bassani, MD; Robert Elliott, MD; Shaun Rodgers, MD; Amr Morsi; Eric Geller; Chad Carlson, MD; Orin Devinsky, MD; Werner Doyle, MD (New York, NY)

Introduction: We analyzed the efficacy of vagus nerve stimulation (VNS) in a large series of consecutive children = 18 years old with medically-intractable epilepsy (MIE).

Methods: A retrospective review of 141 children (75 females and 66 males) with MIE who underwent VNS implantation between November 1997 and April 2008 with at least 1 year of follow-up. Mean age at time of VNS insertion was 11.1 years (range: 1 to 18 years). Eighty-six children (61.0%) were 12 years of age or younger at time of VNS insertion. The median seizure frequency prior to implantation was 10 per week and patients were taking a median of 3 anti-epileptic drugs (AEDs).

Results: Follow-up is available for 89.4% of patients at a mean duration of VNS therapy of 5.2 years (range: 1 week to 11.4 years). Seizure frequency significantly improved with VNS therapy (mean reduction: 58.9%; $p<0.0001$) without a significant reduction in antiepileptic medication burden (median AEDs: 3). At least 50% reduction in seizure frequency occurred in 64.8% of patients and 42.2% of patients experienced at least a 75% reduction.

Conclusion: VNS is a safe and effective treatment for MIE in young adults and children. Over 50% of patients experienced at least 50% reduction in seizure burden. Children 12 years and younger had similar response to VNS as did older children with no increase in complications. Given the demonstrated efficacy of this device and the devastating effects of persistent epilepsy during critical developmental epochs, randomized trials are needed to expand the indications for VNS to include younger children.

23. Complex Pediatric Cervical Spine Surgery Using Smaller Non-Traditional Screws and Plates

Mahesh Karandikar, MD, PhD; Anthony Avellino, MD, MBA; Tong Yang, MD, PhD; Wally Krengel, MD; Kit Song, MD; Sohail Mirza, MD (Seattle, WA)

Introduction: The treatment of craniocervical instability in children is often challenging due to their small spine bones, complex anatomy, and unique syndromes. The authors discuss their surgical experience in the treatment of 33 children (17 years of age and younger) (35 operations) with craniocervical spine instability using smaller non-traditional titanium screws and plates as well as the intraoperative CT scanner.

Methods: Non-traditional spine hardware included smaller screw sizes (i.e., 2.4 mm and 2.7 mm) from the orthopaedic hand/foot set and mandibular plates.

Results: The mean age was 9.5 years (range: 2-17 years). Twelve children underwent a posterior C1/C2 transarticular screw fusion, 17 had an occipito-cervical fusion, 2 had an anterior cervical discectomy and fusion, and 3 had a posterior subaxial cervical fusion. Follow-up ranged from 2 to 72 months. All children had successful fusion at their three-month follow-up visit. Of the 47 C1/C2 transarticular screws that were placed, thirteen were 2.4 mm, fifteen were 2.7 mm, seven were 3.5 mm, and twelve were 4.0 mm. Nineteen of the 47 placed C1/C2 transarticular screws were sub-optimally placed. Fourteen of these misplaced screws were removed and redirected within the same operation. The intraoperative CT scanner enabled us to reposition suboptimal C1/C2 transarticular screws without necessitating a second operation.

Conclusions: Successful craniocervical fusion procedures were achieved using smaller non-traditional titanium screws and plates. The intraoperative CT scanner was a helpful adjunct to confirm and readjust the trajectory of the screws prior to leaving the operating room, which decreases overall treatment costs and reduces complications.

24. Motion Segment Sparing Repair of Symptomatic Chronic Pars Defects

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Introduction: Current standard of care for symptomatic, chronic spondylolysis (SP) is a one-level posterior spinal fusion for defects at L5 (PSF L5-S1) and direct pars repair (motion segment sparing) for more rostral SP if no disk degeneration or listhesis is present. Since many SP patients receiving operative repair are young, a procedure with the lowest biomechanical profile is desirable, recommending direct pars repair in as many patients as possible. We explore the limits of direct pars repair.

Methods: A retrospective review was performed of all patients receiving direct repair of SP between 2002 and 2009. Data was analyzed for predictors of symptom relief and radiographic fusion failure.

Results: Of 49 patients, only 7 required a re-operation to treat clinical symptoms, 6 were female ($p = 0.049$). All treatment failures had bilateral L5 SP. Patients with a slip percentage as high as 30% experienced radiographic fusion and symptom relief. Disc degeneration (measured by the Modified Pfirrmann Scale) did not predict symptom persistence or radiographic fusion failure. Patients with high grade disk disease experienced symptom relief. We found no predictors of treatment failure.

Conclusions: The number of patients receiving motion segment sparing fusions of symptomatic, chronic SP may be safely increased to include patients with grade I spondylolisthesis as well as high grade disk disease. Female patients with bilateral L5 SP and low lordotic angles may be better served by a posterior spinal fusion from L5 to S1.

25. The Use of the Inside-Outside Fixation Technique for Pediatric Occipito-cervical Fusion

Eric A. Sribnick, MD, PhD; Vladimir Y. Dadashev, MD; Barunashish Brahma, MD; David M. Wrubel, MD (Atlanta, GA)

Introduction: Pediatric atlanto-occipital instability involves a wide variety of etiologies: post-traumatic, congenital disease, anatomic abnormalities, and post-operative. Craniocervical fusion is complicated by smaller bony structures and by syndromic alterations in the normal craniocervical anatomy. In addition, fixation would ideally be possible with limited use of external orthotics. The use of the inside-outside stabilization technique has been described in adult patients and involves the use of cranial bolts placed inside-outside and attached to a screw-rod cervical fixation system. One benefit of this system is that the occipital screw heads are intracranial, and the screw threads are pointing externally, eliminating the possibility of directing the screws into the cerebellum. Biomechanical studies have shown a greater pull-out strength for inside-outside constructs, as compared to conventional craniocervical constructs.

Methods: Our study describes the use of the inside-outside screw technique in 20 pediatric patients, including 3 patients 3 years or younger and 9 patients 10 years or younger. Indications for occipital-cervical fusion included 7 post-traumatic patients, one post-operative patient, and 12 patients with congenital disease.

Results: Halo orthosis was required in only one patient. An average follow-up for these patients was 15 months, and to date, none have required re-operation. In patients with an appropriate interval from surgery, bony fusion has been demonstrated.

Conclusions: This study characterizes the use of the inside-outside technique for occipital cervical instability in the pediatric population. Despite these patients having a wide range of ages and etiologies for their instability, use of this technique has resulted in an excellent fusion rate with limited complications.

26. Surgical Management of Non-Traumatic, Subaxial Cervical Spine Deformity/Instability in Children Utilizing Rigid Internal Fixation Constructs

Ian S. Mutchnick, MD; Charles B. Stevenson, MD; Alvin H. Crawford, MD; A. Atiq Durrani, MD; Francesco T. Mangano, DO (Cincinnati, OH)

Introduction: Progressive and sometimes extreme subaxial cervical deformity and subsequent myelopathy accompanying uncommon conditions like Larsen syndrome pose unique clinical challenges to pediatric spine surgeons. Experiential and technological advances in rigid internal fixation techniques have afforded the opportunity for greater success in treating children with such complex cervical deformities.

Methods: We retrospectively reviewed the charts of children undergoing rigid internal cervical fixation for non-traumatic subaxial cervical instability/deformity (congenital or secondary to neoplasia) at Cincinnati Children's Hospital over a 5-year period.

Results: Seventeen patients were identified, with a mean age of 8.1 years (range 7 months-18 years). Clinical diagnoses included Larsen syndrome, Klippel-Feil, hemivertebrae/butterfly vertebrae, neurofibromatosis-type 1, cervical myelomeningocele, chondrodysplasia, Morquio syndrome, spinal muscular atrophy, and multilevel cervical disconnection syndrome. Nine patients had anterior and posterior constructs placed; 8 children underwent posterior fixation only. Anterior constructs consisted of either corpectomies or diskectomies with structural allografts and rigid plating. Posterior fixation was achieved with screw/hook-rod constructs. Followup ranged from one month to four years (mean 13 months), with most patients achieving evidence of bony fusion on radiographic studies by three months postoperatively. All patients with preoperative symptoms experienced clinical improvement. Five of seventeen patients required inpatient rehabilitation for persistent functional deficits; all demonstrated objective postoperative gains by the children's functional independence measure (WeeFIM).

Conclusions: Multisegmental rigid internal fixation constructs can be effective in obtaining and maintaining satisfactory alignment/stability in children with complex cervical deformity. Continued refinement of fixation techniques and fusion adjuncts should allow for improved fusion rates and prevention of myelopathy in this challenging patient population.

27. When Can We Not Screen Infants for Tethered Spinal Cord? An Analysis of Presenting Factors in 1141 Infants

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Introduction: Certain cutaneous stigmata and congenital anomalies are accepted as sufficient reason to perform lumbar imaging to rule out tethered spinal cord. A low risk midline skin stigmata group was recently identified in which the need for lumbar imaging was questioned. The purpose of this study was to correlate presenting skin or congenital findings with lumbar imaging results.

Methods: 1273 infants underwent LUS screening for tethered cord at a major pediatric tertiary referral center over a 5 year period. 1141 had adequate documentation for retrospective chart review. Referral sources included urban academic, urban private practice, and surrounding rural private practice pediatricians. Presence of cutaneous stigmata and/or congenital anomalies and LUS results on all patients were recorded. When available, MRI and surgical findings were recorded.

Results: Sacral dimple (638, 66%) and hair patch (96, 10%) were the most common cutaneous reasons for LUS referral. 37 patients (4%) were referred for deviated gluteal folds and none were associated with an abnormality on imaging. The relative risk for any combination of lesions was 0.93 (CL 0.23, 3.67). Imperforate anus (44, 29%) and TEF/esophageal atresia (31,21 %) were the most common congenital reasons for referral and 8 (18%) and 2 (6%) were associated with abnormal findings on imaging.

Conclusions: Deviated gluteal folds alone do not appear to be associated with abnormal LUS findings and clinicians may consider excluding these from screening. Other cutaneous and congenital anomalies as discussed appear to warrant lumbar imaging. Combinations of cutaneous lesions do not appear to increase the risk of abnormal imaging.

28. Validity of Rapid Sequence Magnetic Resonance Imaging (MRI) in Pediatric Brain Trauma

Dhruve S. Jeevan, MD; Jayson A. Neil, MD; Jennifer Ronecker, BS; Avinash Mohan, MD; Michael Tobias, MD (Valhalla, NY)

Introduction: Rapid-Sequence (RS) Magnetic Resonance imaging (MRI) was originally used to assess ventricular size in shunted hydrocephalus. The indications for its use have since widened at many institutions. We set out to check the validity of this imaging modality in the setting of pediatric head trauma.

Methods: A retrospective evaluation was performed of all pediatric patients presenting to our institution with minor head injuries (GCS >13), between July 2009 and September 2010. All patients had received RS-MRI as a secondary study. These studies where then compared with initial presentation CT scans, along with their clinical significance.

Results: A total of 50 pediatric patients presenting at our institution with minor head injuries underwent RS MRI, in addition to initial presentation CT imaging. A further 10 underwent rapid MRI as part of their initial evaluation. Pathology included EDH (3), SDH (8), skull fracture (35), SAH (7), and cerebral contusion (17). RS MRI validated prior CT pathology in all cases. In approximately 10% RS MRI established the presence of other co-existing pathologies (70% contusions, 5% diffuse axonal injury, 5% chronicity of SDH). RS MR imaging was performed between 4 hrs and 7 days following initial imaging, where CT was the primary imaging modality.

Conclusions: RS MRI provides a safe and effective means of imaging in mild pediatric head trauma, while reducing radiation exposure without the need for sedation. A prospective study in validating RS MR imaging as a primary modality in pediatric trauma is underway, along with optimizing imaging protocols.

ORAL ABSTRACTS

29. Intraarterial Delivery of Human ES Derived Neural Stem Cells in a Neonatal Rat Model of Hypoxic-Ischemia Leads to Functional Recovery

Sahar Rosenblum, BS; Joshua Y. Chua, BS; Tenille N. Smith, MD; Nancy Wang, BS; Hotaik Sung; Raphael Guzman, MD (Stanford, CA)

Introduction: Acute hypoxic-ischemic events in neonates contribute to motor and cognitive developmental delay. Our objective was to investigate if human embryonic derived neural stem cell (hNSC) transplantation improves functional recovery after hypoxic-ischemia (HI).

Methods: Neonatal Wistar rats underwent HI on post-natal day 7 (P7) and were injected intra-arterially with 500,000 fLuc/eGFP transduced hNSCs at P10. Bioluminescence images were obtained immediately, 24 hours post injection, and following behavioral testing. Stroked size was quantified by the ratio of non-stroked/stroked hemispheres using ImageJ. Elevated open-arm maze test was conducted at P26. Quantitative RT-PCR was performed on hNSCs and post-stroked brains.

Results: Infarct size was similar in cell treated animals (15.5% +/-8.5% of total hemisphere size) compared to vehicle treatment (15.3% +/- 12.3%). Bioluminescence imaging demonstrated significant cell homing to the stroked hemisphere with the signal above background at 6 hours ($p<0.0001$) and 24 hours ($p=0.0185$) after injection, but not at P26. Behavioral testing on elevated open arm at P26 revealed that cell-treated animals exhibited improved functional recovery as compared to PBS-injected animals ($p=0.026$). RT qRT-PCR indicated that hNSCs expressed adhesion molecules, chemokine receptors (VCAM-1, PCAM-1, ICAM-1, NCAM-1, CXCR4) as well as neurotrophic (BDNF), angiogenic mediators (HIF-1) and immunomodulatory factors (TNFa).

Conclusion: Intra-arterial hNSC delivery following HI in neonatal rats resulted in early hNSC homing to the injured brain supported by the expression of receptors involved in cell adhesion and chemoattraction. Additionally, The stem cell treatment resulted in functional improvement at 3 weeks after stroke possibly mediated through stem cell secreted neuroprotective, immunomodulatory and pro-angiogenic factors.

30. The Impact of Attention Deficit- Hyperactivity Disorder on Recovery from Closed Head Injury

Christopher M. Bonfield, MD; Stephanie Greene, MD (Pittsburgh, PA)

Introduction: Closed head injuries in children are an important public health issue. The development of ADHD after pediatric CHI is well-known. This study was designed to explore the impact of a premorbid diagnosis of ADHD on outcome after CHI.

Methods: The charts of all patients admitted to Children's Hospital of Pittsburgh with a diagnosis of CHI and ADHD from January 2003 through May 2010 were retrospectively reviewed. IRB approval was granted. Patient demographics, initial GCS, and King's Outcome Scale for Childhood Injury (KOSCHI) score were recorded. The results were compared to published historical controls.

Results: 63 patients with ADHD and CHI were included in the statistical analysis, with a mean age of 12.2 (range 6-17). 90.5% were male. The most common mechanisms of injury were fall (25.3%) and bicycle accident (19%). CHI was defined as mild (GCS 13-15; 48 patients), moderate (GCS 9-12; 6 patients), or severe (GCS <8; 9 patients). For severe CHI patients with ADHD, 22.2% died and 11.1% were severely disabled (KOSCHI score 3A) at followup. 44.4% were moderately disabled (KOSCHI score 4B), and 22.2% had good outcomes (KOSCHI score 5A or 5B). Of severe CHI patients without ADHD, 8.2% were severely disabled, 63.8% were moderately disabled, and 36.2% had good outcomes.

Conclusions: Male patients with ADHD were far more likely to have a CHI than either male patients without ADHD or female patients with ADHD. Patients with ADHD who sustained severe CHIs were more likely to be severely disabled or die than those with severe CHIs in the absence of ADHD.

31. The Pediatric Cervical Spine Instability Study

Douglas L. Brockmeyer, MD (Salt Lake City, UT); Brian Ragel, MD (Portland, OR); John Kestle, MD, MSc (Salt Lake City, UT)

Introduction: Cervical spine clearance in comatose, intubated children after trauma is a difficult and imprecise task. We studied the value of four different radiographic modalities to accomplish that goal.

Methods: In a prospective IRB-approved study, 24 comatose, intubated children with severe traumatic injuries were examined. Patients had plain x-rays, flexion-extension x-rays under fluoroscopy, CT scanning and MRI of their cervical spine within 10 days of admission. Sixteen patients underwent follow-up cervical spine flexion-extension x-rays 2-3 months after their trauma to detect if late instability was present.

Results: Patient ages ranged from 4 months to 16 years of age. Six children were victims of non-accidental trauma, five were in motor vehicle collisions, four were in ATV accidents, two were auto-pedestrian accidents, four suffered from falls, and three had miscellaneous mechanisms. The sensitivity and specificity for each radiographic modality in determining cervical spine instability in the patient population was as follows: Plain cervical spine x-rays, sensitivity=100%, specificity=95%; Flexion-extension x-rays, sensitivity =N/A, specificity =100%; CT, sensitivity =100%, specificity =95%; MRI, sensitivity = 100%, specificity =74%.

Conclusions: There was a low prevalence of cervical instability (4%). Plain x-rays, flexion/extension x-rays and CT all had very high sensitivities and specificities. MRI had a high false-positive rate, leading it to be sensitive but not very specific. These data support using flexion-extension x-rays with fluoroscopy and not MRI to definitively rule out cervical ligamentous instability. As always, an abnormal screening cervical spine x-ray or CT scan should lead to appropriate follow-up.

32. Modern Multimodality Management of Aneurysmal Bone Cysts of the Spine in Children

Shobhan H. Vachhrajani, MD; Michael Ellis, MD; Gregory Albert, MD; Abhaya V. Kulkarni, MD, PhD; Peter B. Dirks, MD, PhD; James T. Rutka, MD, PhD; Reinhardt Zeller, MD; Derek Armstrong, MD; James M. Drake, MD (Toronto, Canada)

Introduction: Aneurysmal bone cysts (ABCs) are benign, non-neoplastic lesions that infrequently affect the pediatric spine. Managing ABCs is challenging, and often requires a multi-modality approach including pre-operative embolization and surgical resection with or without spinal instrumentation. We summarize our modern institutional experience and address the challenges of managing ABCs in the pediatric population.

Methods: We retrospectively reviewed the clinical, neuroimaging, and pathological features as well as treatment outcomes for children with spinal ABCs treated at the Hospital for Sick Children, Toronto, Canada over the past 10 years.

Results: Since 2000, 10 patients (4 male, mean age 9.6 years at presentation) were treated for spinal ABC at our institution. Seven patients presented with axial pain alone while 3 presented with axial pain and radiculopathy. ABCs locations included 3 cervical, 4 thoracic, 2 lumbar, and 1 sacral. Spinal angiography was performed in 5/10 patients with 2 undergoing embolization. Surgical resection was carried out in 9/10 patients with 8/10 undergoing concomitant spinal fusion. Average blood loss per patient treated with surgery was 2200mL. No associated malignancies were found. One patient died, attributed to a complication of percutaneous embolization. All remaining patients were neurologically intact at a mean follow-up duration of 30.2 months.

Conclusions: Management of ABCs of the spine in children remains challenging due to the vascular nature of these lesions, associated bony destruction, and ongoing growth of the pediatric spine. Complete surgical resection with spinal instrumentation is often necessary to provide cure and prevent spinal deformity.

33. Retrospective Study of Spinal Metastasis of Pilocytic Astrocytoma

Joseph Chung, BS; Mark Krieger, MD; Ira Bowen, BA; Yasser Jeelani, MD; J Gordon McComb, MD (Los Angeles, CA)

Introduction: Pilocytic astrocytoma is the most common CNS glial tumor in children, accounting for a majority of pediatric cerebellar tumors. Rarely, juvenile pilocytic astrocytoma can spread from the brain to the spinal cord. Previous studies have consisted of case reports. The purpose of this study was to evaluate the incidence of pilocytic astrocytoma dissemination to the spine and identify patient factors and radiographic features that may help guide treatment.

Methods: In this IRB-approved study, operative reports, clinic notes, and radiographic images of 151 children with pilocytic astrocytomas were retrospectively reviewed.

Results: 9 of these patients had spine involvement. Mean age of the patients at diagnosis was 7 years. 2 patients presented with disseminated spinal disease, and 7 had subsequent spread, at an average time of 4 years. In nearly all the patients, the tumor metastasized to the cervical spinal cord. In two of the patients, the tumor also metastasized to the thoracic and lumbar spinal cord, whereas one of the patients had a metastasis purely localized to the lumbar spinal cord. Eight out of the nine patients in this study underwent a craniotomy and received chemotherapy. 4 of the patients also experienced recurrent brain tumors prior to the spinal cord metastasis. 6 died within 3 months; 3 survived with follow-up of 1-4 years.

Conclusions: This study contains one of the largest collections of patients who have experienced spinal metastasis of pilocytic astrocytoma. In addition, this study suggests prognostic factors that may potentially lead to recurrence and/or dissemination.

34. A Retrospective Study on the Survivability of Children with Ependymomas From 1975-2000

Maureen A. Darwal, BA; Bradley T. Bagan, MD; Mirza N. Baig, MD, PhD; Robert A. Hirschl, MD; Chris S. Karas, MD (Des Moines, IA)

Introduction: Ependymomas are the third most common pediatric brain tumor and have been historically difficult to treat. The purpose of this study is to examine survivability trends of pediatric patients diagnosed with an ependymoma from 1975 to 2000 using the SEER Program.

Methods: SEER*Stat software available at www.seer.cancer.gov/seerstat version 6.6.2 and the database, Incidence - SEER 17 Regs Research Data + Hurricane Katrina Impacted Louisiana Cases, Nov 2009 Sub (1973-2007 varying), were used to collect the survival rates of 496 pediatric patients diagnosed with an ependymoma. The patients were grouped by age as follows: 0-1, 1-4, 5-9, 10-14, 15-19 years old. Survival rates were analyzed at months 1, 3, 6, 9, 12, 24 and 60.

Results: Age group 5-9 had the largest increase (3.07%) in survival for the 1 month time period, while ages 1-4 had a regression in survivability (-6.31%). Age group 0-1 had the largest increase in survival for the 3, 6 and 9 month time period (32.36%, 82% and 87.62% respectively). While the 0-1 age group continued to increase in survival at 12 months, the 5-9 age group had a regression in survival (-24%). At 24 and 60 months, 0-1 age group had the greatest (500% and 95733% respectively). Overall, the 15-19 age group had the smallest average increase in survival (2.98%) and ages 0-1 had the greatest (136%).

Conclusions: Improvements in the treatment of pediatric ependymomas over the last 35 years have yielded modest gains in survivability. These gains have been especially notable in the younger ranges of the pediatric population.

35. Intraventricular Lesions in Tuberous Sclerosis Complex: A Possible Association with the Caudate Nucleus

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Introduction: Tuberous sclerosis complex (TSC) typically manifest with three intracranial pathologies: cortical tubers, subependymal nodules (SENs), and subependymal giant cell astrocytomas (SEGAs). We analyzed the radiological findings of intraventricular lesions in a large cohort of patients with TSC.

Methods: We retrospectively reviewed brain MRI scans of TSC patients for whom at least one electronically stored cranial MRI was available. Collected data included MRI characteristics, location, size, and appearance of all intraventricular lesions.

Results: 560 scans in 103 patients were reviewed. Twenty-four patients had more than four years of radiological follow up. Twenty-two patients with >4 years of follow up had 34 lesions along the caudate-thalamic groove (CTG), of which 23 were stable and 11 grew. All other intraventricular lesions were stable. The 103 patients had a total of 496 intraventricular lesions. 157 lesions were located along the CTG in 88 patients. Twenty SEGAs were operated on. The remaining 339 lesions were distributed along the lateral ventricle, always in contact with the course of the caudate nucleus, and are presumed to be SENs.

Conclusions: Intraventricular lesions in TSC patients are located at the CTG area, and along the lateral aspect of the lateral ventricles, atrium, and temporal horn. Their location exclusively follows the course of the caudate nucleus. Only lesions along the CTG showed the potential to grow, and were then identified as SEGAs. The remaining lesions are SENs. Understanding why these lesions develop in relation to the caudate nucleus may offer insights into therapy.

36. Poorly Differentiated Chordomas Commonly Lose INI1 Expression: A Clinicopathologic Study of 4 Cases with Comparison to Typical Chordoma and Atypical Teratoid Rhabdoid Tumor

Melanie G. Hayden, MD; Bret C. Mobley, MD; Katherine Callahan, MD; Jesse K. McKenney, MD; Athena M. Cherry, PhD; Dana C. Bangs; Kristen W. Yeom, MD; Paul G. Fisher, MD; Michael S.B. Edwards, MD; Hannes Vogel, MD (Stanford, CA)

Introduction: Chordomas are malignant bone neoplasms, typically found in the adult axial spine. When chordomas arise in pediatric patients they are more likely to display unusual histologic features and aggressive behavior. We have recently noted an absence of INI1 (hSNF5/SMARCB1) expression by immunohistochemistry in poorly differentiated chordomas, which prompted this current study.

Methods: Immunohistochemical expression of brachyury and INI1 was evaluated in a series of four poorly differentiated chordomas, ten typical chordomas, and eight atypical teratoid rhabdoid tumors.

Results: All fourteen chordomas expressed brachyury (including the four poorly differentiated tumors), and all eight atypical teratoid rhabdoid tumors were negative. All four poorly differentiated chordomas and the eight atypical teratoid rhabdoid tumors lacked nuclear expression of INI1, while the ten typical chordomas maintained strong nuclear INI1 immunoreactivity.

Conclusion: Poorly differentiated chordomas commonly show an absence of INI1 expression, but can be distinguished from atypical teratoid rhabdoid tumors by maintained strong nuclear brachyury expression. Our findings suggest a role for INI1 in the subset of chordomas with aggressive features.

ORAL ABSTRACTS

37. Mini-Craniotomy Versus Burr Hole for Evacuation of Chronic Subdural Collections in Infants

Paul Klimo, MD, MPH (Memphis, TN); Anne Matthews, NP; Sean Lew, MD; Marike Zweinenberg-Lee, MD; Bruce A. Kaufman, MD (Milwaukee, WI)

Introduction: A variety of surgical interventions are used to evacuate infantile chronic subdural collections. We describe a surgical technique that includes a mini-craniotomy and compare that technique to the burr hole technique (both techniques include placement of subdural drains).

Methods: This single-institution retrospective study evaluated 26 patients who underwent treatment for chronic subdural collections (CSC). Preoperative, intraoperative and postoperative data was reviewed, including radiographic findings (density of the subdural fluid, ventricular and subarachnoid space size), neurologic exam, and intraoperative fluid description. The primary outcome was treatment failure, defined as the patient requiring any subsequent surgical intervention after performing the index procedure (mini-craniototomy or burr hole).

Results: The average follow-up for each treatment group was just over 7 months. Treatment failure occurred in 2 out of 15 mini-craniotomy patients (13%), compared with 5 out of 11 burr hole patients (45%, p=0.08). Furthermore, the 2 mini-craniotomy treatment failures required 1 subsequent surgery each, whereas the 5 treatment failure patients in the burr hole group required collectively 9 subsequent surgeries. Eventually, 80% of the mini-craniotomy and 70% of the burr hole patients had resolution of the subdural collections on the last imaging study.

Conclusions: The mini-craniotomy technique appears to be a superior technique for the treatment of chronic subdural collections in infants compared with burr hole evacuation. Mini-craniotomy allows for greater visualization of the subdural space, more aggressive evacuation of the fluid, better irrigation of the space, and the access to fenestrate any loculations.

38. Traumatic Spinal Injuries in Children

Michael Vassilyadi, MD, FRCSC; Christopher Kim, MSc; Paul Moroz, MD (Ottawa, Canada)

Introduction: Spinal injuries in children, although uncommon compared with adults, may contribute to significant morbidity and mortality. These children can have spine fractures with or without myelopathy, or spinal cord injury without radiological abnormalities.

Methods: Between 1990 and 2004, 187 children with spinal injuries were retrospectively reviewed using ICD-10 codes, the Children's Hospital of Eastern Ontario trauma registry and an independently maintained fracture database.

Results: The mean age on admission was 11.8 4.4 years with a male to female ratio of 1.1:1. The age distribution of spinal injuries was highest in the 12 to 16 year-olds, with most injuries at 15 years of age. The top three mechanisms of spinal injury were motor vehicle related (49%), sports (29%), and falls (14%). Myelopathy occurred in 12% of all injuries. Of the 22 children with myelopathy, 12 presented with transient and 10 with permanent neurologic deficits. There were 2 SCIWORAs, 16 spinal cord injuries with fractures and 4 spinal cord injuries with radiological abnormalities other than fractures. The most common spine levels injured were between L2 and sacrum, followed by noncontiguous levels. Associated injuries, including fracture/dislocations (28%) and head injuries (16%), occurred in 56% of children. Overall mortality rate was 4%.

Conclusions: This study has combined patients seen in a level 1 pediatric trauma centre by Orthopedics and Neurosurgery. The results at CHEO are consistent with the few studies in the literature indicating that the highest risk of injury is in the more active adolescent males. Efforts should continue to educate children, especially teenagers, about injury prevention.

39. Cranioplasty Following Decompressive Craniectomy of Traumatic Brain Injury in the Pediatric Population

Margaret Riordan, MD (Syracuse, NY)

Introduction: Although cranioplasty is a frequent neurosurgical procedure, the timing and types of flaps used after decompressive craniectomy are not standard. Different neurosurgical preferences and habits could affect outcome and complications.

Methods: The medical records of pediatric patients who underwent cranioplasty after decompressive craniectomy at SUNY Upstate Medical University between January 2003 and April 2010 were reviewed. The time from the original surgery to cranioplasty flap and the type of material used were recorded. Associated complications and shunting pre- or post-cranioplasty were analyzed.

Results: The average time to cranioplasty was 7.5 months (range one to 22 months). Five bone flaps put back in, 11 synthetic flaps (poreous polyethylene, polymethylmethacrylate, cement), and one had a combination of his bone flap and synthetic material were used. Complications included one abscess, two wound infections, two fractures, one bone resorption, one post-operative subdural fluid collection, and one cosmetic revision. Six patients required flap replacement for infection, fracture, or bone resorption and the average time to replacement was 12.5 months. Six patients required ventriculoperitoneal shunt placement. Five patients had the shunt placed pre-cranioplasty and one post-cranioplasty. None of the shunts were removed post-cranioplasty.

Conclusions: Synthetic bone flaps, regardless of material, were associated with fewer complications. Hydrocephalus was not related to replacement of the bone flap.

40. Temporary Shunts in Young Children

Julian J. Lin, MD; Brandon J. Bond, BA; William C. Lee, MD (Peoria, IL)

Introduction: Despite the noteworthy frequency of chronic extra-axial fluid collections seen in young children, no consensus of opinion for surgical management exists. This retrospective review analyzes the results of temporarily shunting young children for the evacuation of such collections, including the use of subgaleal-to-peritoneal shunts.

Methods: The clinical course of young children shunted for extra-axial fluid collections at our institution spanning from 2004 to 2010 were retroactively reviewed and analyzed.

Results: Twenty six children (77% male) ranging in age from 2 to 41 months (mean=8.1, median=4.9) were identified: 22 chronic subdural hemorrhages, 2 intracranial arachnoid cysts, and 2 pseudomeningoceles. The most common clinical presentations were full fontanels (69%), irritability (46%), macrocephaly (38%), lethargy (31%), and seizures (27%). Nineteen children (73%) were victims of non-accidental trauma. Treatments included any combination of subdural-to-peritoneal shunting (85%), percutaneous subdural tapping (69%; mean=2.9 per child), subgaleal-to-peritoneal shunting (8%), cystoperitoneal shunting (8%), external subdural drainage (8%), and/or cyst fenestration (4%). Shunting was the primary treatment for 8 children, secondary for 17, and quaternary for 1. Of the 26 shunts implanted, 16 (62%) have thus been removed due to a satisfactory clinical picture, and 1 was converted to a ventriculoperitoneal shunt. Mean implant duration was 469 days (median=369). Mean post-shunt hospitalization was 4.5 days with 11 (42%) discharged within 1 day. There were 5 shunt revisions in 4 children.

Conclusion: Temporary shunting of chronic extra-axial and subgaleal fluid collections in young children is a definitive clearance treatment with an acceptable complication rate, low risks of shunt dependency, and favorable outcome.

41. The Effect of Gel Film on Retethering of Complex Closed Neural Tube Defects

Jesse Winer, MD; Daniel Solchanyk, BS; Ira Bowen, BA; Alex Tuchman, MD; Mark Krieger, MD; J Gordon McComb, MD (Los Angeles, CA)

Introduction: One of the goals of the repair of closed neural tube defects (NTD) in children is to effect a durable untethering of the spinal cord. Symptomatic re-tethering requiring surgical intervention has been described in 14-44% of patients, and may be associated with significant morbidity. In this study, we evaluate our practice of placing GELFILM intradurally at the time of initial repair of closed neural tube defects on the rate of re-tethering. GELFILM is an absorbable gelatin film that is non-conducive to inflammatory reaction allowing sufficient time for dural and arachnoid healing and regeneration.

Methods: This IRB-approved retrospective review of patients who underwent treatment of NTD over the past 10years. Operative technique and clinical follow up were reviewed as was incidence of surgical intervention for re-tethering; this was compared to a meta-analysis of published rates.

Results: 127patients were reviewed, and follow up data was available for 127(98.4%). All had GELFILM placed intradurally at the time of initial repair. Average follow up time was 61.1months(0.2-246).The median age was 36.2months(0.03-227). 7.2% of patients required surgical intervention for re-tethered cord.

Conclusions: In this study, the rate of re-tethered cord requiring surgical intervention is lower than previously reported rates. While many factors may contribute to this finding, it is our hypothesis that our use of GELFILM may aid in allowing the dura and arachnoid layers to heal without forming adhesions. Further studies comparing the use of GELFILM to other dural closure techniques in the repair of tethered cord will be necessary to better elucidate its role in preventing spinal cord re-tethering.

42. Citrobacter Brain Abscesses in Neonates: The Importance of Early Diagnosis and Aggressive Surgical Intervention

Shakeel A. Chowdhry, MD; Alan R. Cohen, MD (Cleveland, OH)

Introduction: Brain abscess is a disease of the young. Citrobacter diversus, a facultatively-anerobic lactose-fermenting gram-negative bacillus, has a strong propensity to initiate brain abscess in neonates, and the outcome is usually poor. The authors report two cases of Citrobacter brain abscess in neonates. Both had a favorable outcome following early diagnosis, and aggressive surgical and medical intervention.

Methods: Case 1 was a 2-month-old boy who presented with a full fontanelle and enlarging head circumference. MRI showed a right holohemispheric multiloculated ring-enhancing mass with edema and midline shift mimicking a malignant brain tumor. A Citrobacter brain abscess was drained. A second surgery was necessary to drain a loculated abscess cavity. He developed seizures secondary to transverse sinus thrombosis that responded to medical therapy. Case 2 was a 6 week old girl who presented with irritability and a full fontanelle. MRI showed a multiloculated right holohemispheric ring-enhancing mass. A Citrobacter brain abscess was drained. A second surgery was necessary for a loculated abscess cavity.

Results: Case 1 made an excellent neurologic recovery with near normal cognitive function on no medication after a follow-up of two years. Case 2 had postoperative seizures requiring antiepileptic medication. She has made a good neurologic recovery with some cognitive impairment after a follow-up of 15 years. She is seizure-free on medication.

Conclusions: Citrobacter diversus has a high propensity to cause brain abscess in neonates. Rapid diagnosis, aggressive surgical therapy, which may entail multiple drainage procedures, and aggressive medical therapy can lead to a favorable outcome even in fulminant cases.

43. Repeated Cerebrospinal Fluid (CSF) Shunt Infections in Children

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Introduction: A small but clinically important group of children experience multiple CSF shunt infections. To better understand them, we (1) determined the rate of re-infection following CSF shunt infection, and (2) described the microbiology of repeated shunt infections.

Methods: The study cohort includes 31 children who developed infection after undergoing both initial CSF shunt placement and treatment for initial CSF shunt infection between 1/1/1997 and 12/31/2006 at a tertiary children's hospital. CSF shunt infection was defined by: 1) presence of bacteria in a Gram stain and/or culture of CSF, wound swab, and/or pseudocyst fluid; 2) documentation of visible hardware; or 3) abdominal pseudocyst. Infection rates were calculated per-patient rather than per-procedure.

Results: Seventeen of the 31 children with second shunt infection developed re-infection, for a re-infection rate of 54.8% (95% CI 37.8-70.8%); as compared to a first shunt infection rate of 21.2% (123/579, 95% CI 18.1-24.8%) and a second shunt infection rate of 25.2% (31/123, 95% CI 18.4-33.6%). Eighteen children (58%) experienced a switch in both microorganism and bacterial origin (e.g. skin to enteric flora) between first and second infections. Of the remaining 13 (42%) children with the microorganism concordance, 5 (38%) were within one month of completion of therapy and none demonstrated development of antimicrobial resistance between first and second infections.

Conclusions: Children with second shunt infection are at extremely high risk for re-infection. Broad spectrum antimicrobials should be used in the empiric treatment of second CSF shunt infections as a switch in causative microorganisms is common.

44. Clinical Symptoms are Equivalent to Imaging in Predicting Shunt Failure in Myelomeningocele Patients

Jeffrey P. Blount, MD; Gavin T. Reed, BS; Chevis N. Shannon, PhD; Curtis J. Rozzelle, MD; John C. Wellons, MD; R. Shane Tubbs, PhD; Jerry Oakes, MD (Birmingham, AL)

Introduction: Patients with neural tube defects (NTD) form an important and unique subset of patients with VP shunts. Their absolute shunt dependence often induces a fragility which mandates timely and accurate diagnosis and decision-making with regard to shunt revision. We observed that clinical symptoms were eclipsing imaging in our decision-making. To investigate the validity of this trend we probed our shunt database to determine predictive values and likelihood ratios of clinical symptoms (CS) and radiographic change (RC) for a positive intraoperative finding (IOF) of occlusion or ventricular catheter adherence.

Methods: The EMR based shunt database at the Children's Hospital of Alabama at UAB was reviewed to identify NTD patients who underwent shunt revision between 2005-2008. Infections were excluded. Records were characterized with regard to CS that triggered recommendation for shunt revision and RC. Predictive values and likelihood ratios were calculated based on these findings.

Results: We identified 138 shunt revisions in patients that had spinal dysraphism. RC was noted in 114 events (82%) and 106 had a positive intraoperative finding resulting in a PPV= 90.2. In 84 events both CS and RC were present. There were 122 events with symptoms triggering decision making and there were 110 positive IOFs resulting in PPV= 93.8. The likelihood ratio for imaging and IOFs was 2.0 and for imaging and symptoms was 1.55 indicating limited contribution for symptoms if imaging changes are noted.

Conclusion: CS are essentially equivalent to RC in predicting shunt occlusion or adherence in children with spina bifida but contribute little if RC is present.

ORAL ABSTRACTS

45. Cost-Effectiveness of Ventriculoperitoneal Shunting in Ethiopia

Jared D. Ament, MD, MPH (Worcester, MA); Yohans Wodaje, MD (Addis Ababa, Ethiopia); Richard Moser, MD, FACS (Worcester, MA); Peter M. Black, MD, PhD (Boston, MA)

Introduction: Ethiopia ranks as one of the poorest nations in the world. With around 1 neurosurgeon/25,000,000 people, hydrocephalus remains a growing pediatric health concern. Neurosurgery has often been considered cost-prohibitive in non-industrialized countries; however, this has not been methodologically examined. We sought to determine the cost-effectiveness (CE) of ventriculoperitoneal shunting (VPS) for pediatric hydrocephalus in Ethiopia.

Methods: In a retrospective chart review, 72 patients at the Black Lion Hospital, Ethiopia, who underwent VPS for hydrocephalus between 2000-2005, were identified. Patients required a minimum of 2 years of follow-up. CE was determined by cost-utility analysis (CUA). Utilities were derived from standardized questions, assessing perceptions; changes in activities of daily living (ADLs); and social benefit. Complications were incorporated into an expected value decision tree. Mortality in our sample at 2 years was 4.7%. Utilities were not normally distributed per Shapiro-Wilk testing.

Results: Median preoperative satisfaction was 2 0.3 out of 10 while 2 year postoperative satisfaction was 7 1.4 out of 10. The mean incremental utility was 0.151. A total discounted incremental QALY gain of 0.269 was obtained. The total cost associated with this utility equalled $1,534 (USD). The cost-utility of VPS in Ethiopia was 5,736 $/QALY. The model was assessed using univariate sensitivity analysis.

Conclusions: VPS has obvious benefits and seems to be cost-effective based on developed-country standards. However, cultural influence and an average per capita income in Ethiopia of $4 USD, makes the conventional 50,000 $/QALY benchmark unrealistic. Thus, further analysis is required to determine a CE benchmark for neurosurgery in this setting.

46 . The Saint Louis Children's Hospital Experience with Endoscopically Assisted Sagittal Synostosis Repair

Manish N. Shah, MD; Amy Lee, MD (St. Louis, MO); Jason D. Petersen, MD (Oklahoma City, OK); Sybill Naidoo, NP; Albert S. Woo, MD; Alex A. Kane, MD; Matthew D. Smyth, MD (St. Louis, MO)

Introduction: This study investigated the differences in effectiveness and morbidity between endoscopically-assisted wide-vertex strip craniectomy with barrel-stave osteotomies and postoperative helmet therapy versus open calvarial vault reconstruction of sagittal craniosynostosis.

Methods: From 2003 to 2010, we prospectively observed 82 children less than 12 months old surgically treated for scaphocephaly. The endoscopic procedure was offered starting in 2006. The data associated with length of stay, blood loss, transfusion rates, operative times and cephalic indices were reviewed.

Results: There were 41 endoscopic patients with a mean age at surgery of 3.6 months and 41 open-vault reconstruction patients with a mean age at surgery of 6.8 months. The mean followup time was 11 months for endoscopic versus 24 months for open. The endoscopic mean operative time was 88 minutes versus 179 minutes for open. The mean blood loss was 29 ml for endoscopic versus 254 ml for open. Only 3 endoscopic cases required postoperative transfusion whereas the mean number of transfusions was 1.5 for the open group. The mean length of stay was 1.2 days for endoscopic and 3.9 days for open. Of endoscopic patients completing helmet therapy, the mean time was 8.9 months. The mean pre- and postoperative cephalic indices (CI) for endoscopic were 68% and 77% at 11 months postoperatively versus 69% and 77% at 22 months postoperatively for open.

Conclusions: Endoscopically-assisted strip craniectomy offers a safe and efficacious treatment for sagittal craniosynostosis that is comparable in outcome to calvarial vault reconstruction with less morbidity and shorter length of stay.

47. Use of Molding Helmet as Primary Treatment of Sagittal Craniosynostosis

Sandeep Sood, MD; Steven D. Ham, DO; Arlene Rozelle, MD (Detroit, MI)

Introduction: Sagittal craniosynostosis is traditionally considered a surgical condition. Poor results of simple suturectomy are from re-closure of the suture. Resulting techniques with wider craniectomy, use of interposing materials have not improved the outcome. Reconstructive strategies evolved such as clam shell operation, pi procedure and total calvarial reconstruction. Endoscopic suturectomy with post operative use of molding helmet has shown good results. Considering the fact that despite suturectomy the bony reunion forms within 8-12 weeks of surgery, we questioned if the improved outcome was primarily related to use of helmet. We describe preoperative use of molding helmet and its effect on head shape in patients with sagittal craniosynostosis.

Methods: Families of two 6 and 8 week old infants, who opted for calvarial reconstruction at 3-6 months instead of endoscopic suturectomy, were agreeable to use of molding helmet pre-operatively. Patients underwent 3D CT scan to confirm craniosynostosis.Followup was at 6 weekly intervals for adjustment of helmet, head circumference measurements, clinical photograph and Cranial Index (CI) measurement.

Results: There was significant improvement in the head shape within 6 weeks of use of molding helmet. CI normalized from 68% to 75% in one at 3 months and was 78% in the other at 5 months. Lack of precedent and parental anxiety prevented us from pursuing conservative treatment. At surgery, fusion of sagittal suture was confirmed.

Conclusions: These cases question the surgical option in patients with sagittal craniosynsotosis and suggest that some patients may not require surgery with early use of molding helmet.

48. Radiation Dose Reduction in Children Undergoing CT Imaging for Craniofacial Surgery

Nathan R. Selden, MD, PhD; Ryne A. Didier, BA; Anna A. Kuang, MD; Daniel L. Schwartz, MD; Donna M. Stevens, MD; Dianna M. E. Bardo, MD (Portland, OR)

Introduction: Pediatric patients are exposed to ionizing radiation during pre- and post-operative evaluation for craniofacial surgery using computed tomographic (CT) imaging. Recent scientific evidence and public disclosure have led to increasing interest in radiation dose reduction for elective cranial imaging, while preserving diagnostic quality.

Methods: In this prospective study 49 patients were positioned during craniofacial CT imaging with their neck fully extended into an exaggerated sniff position, parallel to the CT gantry, to eliminate the majority of the cervical spine and the thyroid gland from radiation exposure. Image quality and effective radiation dose comparisons were made retrospectively in age-matched controls (n=49).

Results: When compared to CT scans reviewed retrospectively, the prospective examinations showed a statistically significant decrease in z-axis length by 16 percent ($p < 0.0001$) and delivered a reduced effective radiation dose by 18 percent ($p < 0.0001$). The subjective diagnostic quality of the exams performed in the prospective arm was generally maintained, with a slight decrease in the quality of brain windows. There was unexpected and statistically significant improvement in the quality of bone windows and three-dimensional reconstructed images.

Conclusions: Altering head position by extending the neck during pediatric craniofacial CT imaging statistically reduces the effective radiation dose while maintaining the diagnostic quality of the images.

49. Intraoperative Estimated Blood Loss Assessment is Unreliable in Extended Synostectomies

Mitchel Seruya, MD; Robert F. Keating, MD; Michael J. Boyajian, MD; John S. Myseros, MD; Amanda L. Yaun, MD; Albert K. Oh, MD (Washington, DC)

Introduction: Intraoperative blood loss remains a significant source of morbidity associated with open craniosynostosis surgery and its measurement remains a challenge. This study of extended synostectomies analyzed the relationship between estimated blood loss (EBL), calculated blood loss (CBL) and patient demographics, transfusion requirements, and hospital length of stay (LOS).

Methods: Infants with sagittal synostosis who underwent extended synostectomies at a single institution from 1997 - 2009 were reviewed. Patient demographics and intraoperative factors, including mean arterial pressure (MAP) and operative time, were documented; statistical analysis of EBL, CBL, intraoperative transfusion of packed red blood cells (RBC), and hospital LOS was performed.

Results: 71 infants were identified. Mean surgical age and weight were 4.9 months and 7.3 kg, respectively. Mean operative time was 1.4 hrs and average intraoperative MAP was 54.6 mmHg. Mean EBL was 72.6 cc and CBL was 135.8 cc, with a distinct lack of correlation. EBL displayed a borderline ($p = 0.053$) association with operative duration. Intraoperative RBC transfusion, which was required in 60% of patients, positively correlated with EBL ($r = 0.69$, $p < 0.0001$) and inversely correlated with CBL ($r = -0.34$, $p < 0.005$). Mean hospital LOS was 2.3 days, without association to EBL, CBL, or fluid requirement.

Conclusion: In extended synostectomies for sagittal synostosis, EBL and CBL demonstrated a decided lack of correlation with one another. Intraoperative blood transfusion requirements positively correlated with EBL but negatively correlated with CBL. These findings highlight the need for reliable, real-time monitoring of intraoperative blood loss to accurately guide blood and fluid resuscitation.

50. Efficacy of Hydromer-Coated Shunt Systems in Reducing Early Shunt Infections

Emil A. Pastrana, MD; Gisela Murray, MD; Samuel Estronza, MD; Ivan J. Sosa, MD (San Juan, PR)

Introduction: Shunt infection are the most common and morbid complication following a cerebrospinal fluid (CSF) diversion procedure. Hydromer-coated catheters (HCC) consist of a hydrophilic surface that is intended to lower bacterial colonization. The objective was to determine the effect in the incidence of early shunt infection in a pediatric patient population after the introduction the hydrophilic polymer catheter shunt system.

Methods: A retrospective analysis of 37 consecutive pediatric patients with hydrochephalus de novo shunted using HCC system was performed. All patients were followed for 6 months. This group was compared to a controlled group of 37 consecutive pediatric patients with HCP de novo treated with standard barium catheters.

Results: The Group A consisted of 37 patients with HCC shunts systems. Of these, 5 patients had early shunt complications: 3 patients with shunt infection, 1 patient with proximal obstruction and 1 patient with distal obstruction. Group A underwent 43 surgeries during the first 6 months following shunt insertion. Group B consisted of 37 patients with non-HCC shunt system. Of these 13 patients underwent revisions during study period which included 10 shunt infections, and 3 proximal obstructions. The infection rate was significantly lower in the Group A when compared to Group B, 8% vs. 29% respectively ($p < 0.05$).

Conclusions: Shunt infection rate was significantly reduced in the pediatric population after the introduction of HCC system. Hydromer-Coated catheters appear to be an alternative to reduce the early infection rate.

51. Normative Brain and CSF Volume Growth Curves for Evaluating Hydrocephalus

Jason G. Mandell, MS; Jacob Langelaan, PhD; Andrew G. Webb, PhD; Steven J. Schiff, MD, PhD (University Park, PA)

Introduction: It has recently been shown that brain and CSF volume could be used to construct normative growth curves in experimental animals, and could discriminate different patterns of hydrocephalus for which linear metrics of ventricular size were insensitive (J Neurosurg Pediatrics 6:1-10, 2010). We here create a method to adapt these findings to generate normative human growth curves for brain and CSF.

Methods: We created a semi-automated method for the extraction of brain and CSF from head images using a particle filter to follow the irregularities of the brain. Our technique has similarities to robotic navigation. With IRB oversight, we applied this technique to 64 T2-weighted MRI images from the NIH Pediatric MRI Data Repository at the Montreal Neurological Institute

Results: Normative growth curves of brain and intra-brain volumes were created for males and females, at ages 2 weeks, 6 months, 1, 2, 3, 6 and 18 years. The male brain grows faster than the female brain, a function of body size, and is slightly larger at age 18. The coefficient of multiple determination values of a least-squares power-law fit for normative male and female brain volumes are 0.86 and 0.90, respectively, suggesting a very good fit.

Conclusions: We have generated, to our knowledge, the first children's normative growth curves for brain and CSF. We demonstrate the utility of these brain and CSF volume measures to aid in the discrimination of neurocognitive outcome in treated hydrocephalic children in a separate abstract submitted to this meeting.

52. Brain and CSF Volumes Discriminate Neurocognitive Outcomes in Hydrocephalus

Jason G. Mandell, MS (University Park, PA); Abhaya Kulkarni, MD, PhD (Toronto, Canada); Benjamin C. Warf, MD (Boston, MA); Steven J. Schiff, MD, PhD (University Park, PA)

Introduction: We treat children with hydrocephalus based upon metrics of head circumference on clinical examination, and indirect metrics of CSF volume such as frontal occipital horn ratio (FOHR) from brain images. We recently created tools to calculate brain and CSF volume in clinical images, and generated the first normative growth curves for brain and CSF in children (reported in a separate abstract submitted to this meeting). We here apply these volumetric tools to a population of spina bifida children with treated and untreated hydrocephalus, whose neurocognitive outcome was found to not correlate with FOHR (J Neurosurg Pediatrics 4:564-570, 2009).

Methods: We optimized our volume extraction technique for CT, and examined 33 scans collected postoperatively. The modified Bayley Scales of Infant Development (BSID-III) test was administered.

Results: FOHR correlated much more strongly with CSF than with brain volume ($R2 = 0.81$ vs 0.11). Each Bayley score demonstrated positive correlations with brain volume and negative correlations with CSF volume. Pooling the 3 most strongly correlating tests - fine motor, expressive language, and cognition - we found that brain and CSF volume discriminated outcomes above and below the cumulative standardized normal score of 30 (Wilks and bootstrap $p<0.01$), and that a 3 group discrimination was also highly significant for scores 0-15, 15-30, and greater than 30 (Wilks $p<0.01$, bootstrap $p<0.02$).

Conclusions: A combination of brain and CSF volume appears significantly more powerful at discriminating good versus poor neurocognitive outcomes in hydrocephalus than either volume alone, or indirect measures of fluid volume such as FOHR.

ORAL ABSTRACTS

53. Endoscopic Third Ventriculostomy for Tectal Plate Gliomas: Long-Term Outcomes and Ventricular Size

Andrew K. Romeo; Rob Naftel, MD; Gavin Reed, MS; Richard Martin, MD; Chevis Shannon, PhD; Paul Grabb, MD; R Shane Tubbs, PhD; John Wellons, MD (Birmingham, AL)

Introduction: Endoscopic third ventriculostomy (ETV) is an excellent alternative to shunt placement in children with hydrocephalus due to tectal plate gliomas (TPG). Controversy remains regarding the amount of ventricular size reduction that should be expected after ETV. This study investigates ventricular size change after ETV for TPG.

Methods: 22 children were identified from a 15 year retrospective database of neuroendoscopic procedures performed at our institution that had at least one year follow-up. Clinical outcomes including need for further CSF diversion and symptom resolution were recorded. The frontal and occipital horn ratio (FOR) was measured on pre and post-operative, 1 year, and most recent brain imaging.

Results: 17 of 22 children (77%) required no additional procedure for CSF diversion. Of those that failed, 4 underwent successful secondary ETV and one required shunt replacement. Therefore, 21 of 22 (96%) maintained successful CSF diversion with ETV. FOR decreased in 89% of children undergoing ETV. FOR progressively decreased 1.7%, 11.2%, and 12.7% on the initial postoperative, one year, and most recent imaging (mean 5.4 years), respectively. When ETV failed, FOR increased at time of failure. Failures occurred an average of 1.6 years after initial ETV. Median follow-up for all 22 patients was 3.4 years.

Conclusions: ETV successfully controlled hydrocephalus in this extended follow-up of patients with TPG. If ETV fails, secondary ETV is a reasonable option, emphasizing the need for follow-up. Most ventricular size reduction appears to occur within the first year with only modest reduction thereafter.

54. Hyponatremia Following Endoscopic Third Ventriculostomy: A Report of Five Cases and Analysis of Risk Factors

Gregory G. Heuer, MD, PhD; Joel A. Bauman, MD; Michael W. Aversano, BS; Matthew R. Sanborn, MD; Arastoo Vossough, MD; Leslie N. Sutton, MD; Phillip B. Storm, MD (Philadelphia, PA)

Introduction: Electrolyte and endocrinologic complications of endoscopic third ventriculostomy (ETV) are infrequent but serious events, likely due to transient hypothalamic-pituitary dysfunction. While the incidence of diabetes insipidus is better known, hyponatremia is not often reported. Here we report a series of 5 patients with post-ETV hyponatremia due to presumptive SIADH.

Methods: The records of patients undergoing ETV from 2008-2010 were reviewed. All ETVs were performed with a rigid neuro-endoscope via frontal burr hole, standard third ventricular floor blunt perforation, Fogarty catheter dilatation, and intermittent normal saline irrigation. Post-operative MRI scans were evaluated for endoscope tract injury as well as sagittal trajectory from burr hole center to fenestration site.

Results: Thirty-two (20:12 M:F) patients underwent ETV. Median age was 4.7 years (range 3 weeks to 28 years). Hydrocephalus was most commonly due to non-tumoral aqueductal stenosis (43%), non-tectal tumor (25%), and tectal glioma (13%). Five patients (16%) had multi-cystic/loculated hydrocephalus. Five patients (16%) developed hyponatremia between 1 and 8 days following ETV, including 2 patients with seizures and 3 patients re-admitted following routine discharge. No hypothalamic injuries were noted on imaging. Univariate risk factors consisted of: age = 2 yrs ($p=0.02$), presence of cystic lesions ($p=0.02$), and trajectory angle = 10 degrees from perpendicular ($p=0.001$).

Conclusions: ETV is a well-tolerated procedure but can result in serious complications. Hyponatremia is rare and may be more likely in younger patients or those with cystic loculations. Patients with altered craniometry may be at particular risk with a rigid endoscopic approach requiring greater manipulation of subforniceal or hypothalamic structures.

55. Complex Chiari 1 Malformations in Children: Analysis of Preoperative Risk Factors for Occipital-Cervical Fusion

Robert J. Bollo, MD; Meghan M. Brockmeyer; Jay Riva-Cambrin, MD; Douglas L. Brockmeyer, MD (Salt Lake City, UT)

Introduction: Chiari type 1 malformation is a congenital anomaly usually treated by suboccipital decompression. Patients who fail to respond to standard surgical management often have complex anomalies of the craniovertebral junction requiring occipital-cervical fusion. We hypothesized "complex" patients with certain risk factors may have a higher rate of occipital-cervical fusion compared to "simple" patients without risk factors.

Methods: We conducted an IRB-approved, retrospective review of clinical and radiographic data in pediatric patients undergoing surgery for Chiari type I between 1995-2010. The following radiographic criteria were identified: scoliosis, syringomyelia, Chiari 1.5, medullary kinking, and ventral brainstem compression (defined as pBC2 greater than 8mm). We performed a statistical analysis to determine the association between occipital-cervical fusion and each variable.

Results: We identified 206 patients who underwent Chiari decompression with or without occipital-cervical fusion, of whom 101 had preoperative imaging available for review. Mean age at surgery was 9.1 years, and mean follow-up was 2.3 years. 83 patients underwent suboccipital decompression alone (mean age 8.6 years). 17 patients underwent occipital-cervical fusion (mean age 11.6 years), either as part of the initial surgical procedure or following failed decompression. Patients who required occipital-cervical fusion were significantly older ($p=0.03$), more likely to have a Chiari 1.5 ($p<0.001$), medullary kink ($p<0.001$), and pBC2 greater than 8mm ($p<0.001$). Scoliosis and syringomyelia were not associated with fusion.

Conclusions: Chiari 1.5, medullary kinking, and pBC2 of greater than 8mm are indicators of a "complex" Chiari malformation. Early occipital-cervical fusion should be considered for those presenting with these complex risk factors.

56. Natural History of Chiari I Malformation after Recommendation for Conservative Management

Jennifer Strahle, MD; Joseph Kapurch, BS; Mohannad Ibrahim, MD; Karin M. Muraszko, MD; Hugh J. L. Garton, MD, MHSc; Cormac O. Maher, MD (Ann Arbor, MI)

Introduction: The natural history of Chiari I malformation (CM) is incompletely understood due to the small size of all prior studies.

Methods: We reviewed the records of 14,116 consecutive children undergoing brain or cervical spine MRI. Of these, 148 patients were diagnosed with CM on the MRI, were not offered surgery at the time of diagnosis, and had at least one year of clinical and MRI follow-up after diagnosis. These patients were included in a natural history analysis. 23 patients had a syrinx diagnosis at the time of CM diagnosis.

Results: 9 of 148 patients had new symptoms attributed to the CM over a mean clinical and MRI follow-up of 4.6 years and 3.8 years respectively. 7 patients had interval development of syrinx; of these, 3 were de novo syrinxes and 4 developed from a pre-syrinx state or dilated central canal. 3 patients had complete resolution of a syrinx. 75 patients had multiple CSF flow studies. Of these, 23 had improvement of CSF flow, 40 had no change, and 12 were worse. There was no significant change in amount of tonsillar herniation (9.6mm vs 9.3mm) over the follow-up. 16 patients underwent CM surgery over the follow-up interval. There were no differences in initial tonsillar herniation or CSF flow in those who ultimately underwent surgery compared with those who did not.

Conclusions: The natural history of CM for those selected for conservative management is generally benign. Symptoms and MRI findings are stable over time in most cases, although spontaneous improvement and worsening can be seen.

57. A Collaborative Effort to Improve Treatment Outcomes: The Park - Reeves Syringomyelia Research Consortium

David D. Limbrick, MD, PhD; T.S. Park, MD (St. Louis, MO)

Introduction: Syringomyelia and Chiari Type I Malformation are closely associated but incompletely understood anomalies of the spinal cord and craniovertebral junction. These conditions affect children and young adults in the prime of their lives and may result in debilitating symptomatology and/or neurological deficits. Syringomyelia in particular is uncommon, and there is dearth of large-scale and long-term studies to address questions regarding if, when, and how to best treat this condition.

Methods: The primary objective of the Park-Reeves Syringomyelia Research Consortium is the creation of a web-based enterprise portal with a comprehensive, multi-institutional database for collection of data, including demographics, clinical/radiographic presentation, detailed surgical treatment approaches, and clinical/radiographic follow-up. De-identified, coded information will be recorded for subjects treated over the past 10 years (retrospective enrollment). Prospective enrollment is expected to continue for a minimum of 3 years.

Results: Data collection for the PRSRC was initiated in the fall of 2010. The consortium anticipates a 3-year period of retrospective and prospective data collection with periodic analysis and updates provided. At the completion of the 3 years, the entirety of the database will be opened to PRSRC Investigators. After an additional year, the database will be made open to the public.

Conclusions: The PRSRC provides a unique, unified platform for large-scale study of syringomyelia and a touchstone for clinical and translational research in the field. Using this vehicle, major questions regarding the clinical management of syringomyelia will be addressed with the goal of establishing evidence-based guidelines for the treatment of this condition.

58. The Chiari O Malformation Revisited

Joshua J. Chern, MD, PhD; Shane Tubbs, PhD; Jerry Oakes, MD (Birmingham, AL)

Introduction: In 1998, our group identified five patients with syringomyelia and no evidence of Chiari I malformation. MR imaging of the entire neuraxis ruled out other causes of a syrinx. Ultimately, abnormal CSF flow at the foramen magnum was the suspected cause. The label "Chiari 0" was used to categorize these patients. All underwent a posterior fossa decompression and duraplasty identical to the technique used to treat patients with a Chiari I malformation. Significant syrinx and symptom resolution has been found in these patients.

Methods: Herein, we report a follow up study of such patients derived from over 500 operative cases of pediatric Chiari I decompression. Fifteen patients were identified. At surgery, many of these were found to have physical barriers to CSF flow near the foramen magnum. In the majority, the syringomyelia was greatly diminished postoperatively. Details of this group will be presented.

Conclusions: We stress that this subgroup represents a very small cohort found within the Chiari malformations. We would emphasize that careful patient selection is critical when making the diagnosis of Chiari 0 malformation. Without an obvious Chiari I malformation, other etiologies of a spinal syrinx must be conclusively ruled out. Only then can one reasonably expect to ameliorate the clinical course of these patients with a posterior fossa decompression.

59. Folic Acid Supplementation Enhances CNS Regeneration In Vitro on Inhibitory CNS Myelin

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Introduction: Unlike embryonic neurons, adult CNS neurons regenerate poorly after injury. We have shown both in vivo and in vitro that folic acid (FA) supplementation enhances adult CNS axonal regeneration significantly. However, our previous models did not take into account the role of glial inhibition of neuronal growth. Here, we examine whether FA enhances growth of neurons on CNS inhibitory media, and compare this growth pattern to the well-established active growth process seen in embryonic neurons.

Methods: Sprague-Dawley rats were subjected to C3-dorsal column transection. The lumbar DRGs were removed and the neurons cultured on myelin isolated from rat brains. The four experimental groups included: FA-treated DRG on untreated myelin (A); untreated DRG on untreated myelin (B); untreated DRG on FA-treated myelin (C); embryonic Day-15 DRG on untreated adult myelin (D). Neurons were fixed and stained at time intervals between 10-48 hours. Axonal elongation was assessed blindly.

Results: Embryonic and FA-treated adult DRG neurons extended long axons on untreated myelin. In contrast, untreated neurons were unable to grow long axons on either FA-treated on untreated myelin at all timepoints ($p<0.05$).

Conclusions: FA supplementation enhances adult neuronal regeneration in vitro on inhibitory CNS myelin, mimicking the growth of embryonic neurons. This indicates that the pro-regenerative effect of folate is neuronal, and that the molecular basis of the regrowth of adult neurons may be recapitulating the growth machinery of the embryonic CNS. Such an effect may have significant impact on our understanding and potential treatment of various developmental and degenerative/traumatic CNS diseases.

60. Magnetic Resonance Imaging Versus Ultrasonography for the In Utero Evaluation of Central Nervous System Anomalies

Pierpaolo Peruzzi, MD; Corey Raffel, MD, PhD (Columbus, OH)

Introduction: The use of Fetal Magnetic Resonance Imaging (F-MRI) for the in utero evaluation of CNS pathology is widely accepted as an adjunct to fetal sonography (F-US). MR imaging is thought to better characterize CNS anomalies and to provide a more exact diagnosis and accurate prognosis. The purpose of this study was to determine the role and indications of F-MRI in evaluating fetuses with different CNS abnormalities seen initially on prenatal sonograms.

Methods: Over 3 years, fetuses with prior sonographic evidence of CNS abnormalities who consequently received prenatal MRI at Columbus Nationwide Children's Hospital within 2 weeks of the F-US were included in this study. Results of the two examinations were then compared in terms of diagnostic accuracy.

Results: Twenty-six fetuses were included in this study. Of these, sixteen had hydrocephalus; 6 spinal dysraphic defects, two had holoprosencephaly, one had an encephalocele, and one had multiple body abnormalities requiring detailed CNS evaluation. F-US provided a correct prenatal diagnosis in 20 cases, while F-MRI was correct in 22 cases. There were a cumulative 9 false positive results for F-US and 7 for F-MRI, while false negatives were a total of 34 and 19, respectively.

Conclusions: F-MRI is more sensitive in detecting fetal CNS abnormalities, but its ability to provide a correct prenatal diagnosis is only marginally superior to F-US. F-MRI is not exempt from misdiagnosis and still shows a significantly high rate of false negative results. Particularly for spinal dysraphic defects, F-MRI does not seem to add important diagnostic nor prognostic details when compared to F-US.

ORAL ABSTRACTS

61. Recurrence of Syringomyelia in Chiari I Etiology: Arachnoid Veil

James M. Shiflett, MD; Michael Muhlbauer, MD; Stephanie Einhaus, MD; Fredrick Boop, MD; Robert A. Sanford, MD (Memphis, TN)

Introduction: Posterior fossa decompression of Chiari I produces resolution of syringomyelia in the vast majority of cases and recurrence is uncommon. When the syrinx recurs what is the etiology and what should be the next surgical procedure? The authors report 4 cases where syrinxs resolved after posterior fossa decompresssion, intradural exploration and dural patch grafting but later recurred. Repeat exploration revealed that the etiology of blocked CSF flow was not the expected post-op tonsilar scarring but an arachnoid veil that occluded the outflow of CSF from the IV ventricle. Lysis of the veil was performed and the syrinxs again resolved. In 2 of the cases the arachnoid veil was observed and opened at the original surgical decompression but had reformed. The authors were only able to find one reference to this arachnoid veil in the world literature. We will discuss the cases, possible implications as to initial surgical options when treating Chiari I with accompanying syrinx, theory as to its occurrence and possible prevention of recurrence.

62. Is Chiari Syndrome without Chiari Malformation Proof of an Anatomical Basis for Chiari Symptomatology?

Ricky Wong, MD; Leila Khorsani, MD; David Frim, MD (Chicago, IL)

Introduction: Chiari malformation type 1 (CM1)-associated anatomic anomalies include cerebellar tonsillar herniation and fourth ventricular outflow obstruction, amongst others. How these and other anomalies result in tussive headache, syrinx, or drop attack is still debated. Theorizing anatomically, the symptoms may be a direct result of fourth ventricular outflow obstruction; theorizing neurophysiologically, primary brainstem malfunction may also cause these symptoms. Observation of several cases of non-Chiari-related fourth ventricular outflow obstruction provide insight into this issue.

Methods: Charts of five patients presenting with anatomic fourth ventricular outflow obstruction not associated with CM1 were reviewed for presenting symptoms. Three of the five underwent surgical restoration of fourth ventricular CSF flow.

Results: Three patients initially presented long after surgery near the foramen of Magendie (1 aneurysm clipping, 2 for tumor resection) with MRI evidence for 4th ventricular outflow obstruction. The fourth presented with a dorsally exophytic medullary mass mimicking herniated cerebellar tonsils, the fifth presented with an intrinsic medullary tumor. Symptoms in these patients included: "Chiari" drop attacks (2 pts), tussive headaches (3 pts), and syrinx (1 pt). Three patients (2 intra-4th ventricular tumor resection and 1 dorsal medullary tumor) underwent surgery restoring CSF flow and completely resolving symptoms.

Conclusions: These observations demonstrate that anatomic fourth ventricular outflow obstruction in and of itself can cause tussive headache, syrinx, and drop attacks which are resolved by restoring CSF flow. An implication is that Chiari syndrome is a combination of anatomically and physiologically induced symptoms.

63. Intraventricular Versus Intrathecal Baclofen for Dystonia: A Comparison of Complications

Brandon G. Rocque, MD; A Leland Albright, MD (Madison, WI)

Introduction: Intrathecal baclofen (ITB) is an effective treatment for secondary dystonia. However, in many patients with dystonia, placement of an intrathecal catheter is difficult due to anatomic anomalies or spinal fusion. Intraventricular baclofen (IVB) has been shown to be an effective alternate route for drug delivery in a small series of patients. The purpose of this report is to present the largest series of IVB cases to date, and compare the complication rate to that of a concurrent cohort of ITB cases.

Methods: The senior author's series of IVB cases were reviewed. All contemporaneous cases of ITB for dystonia were reviewed as a control group. Data were collected by retrospective medical records review.

Results: Twenty-eight IVB patients, and 31 ITB patients were identified. Mean follow up in both groups was 12.7 months. IVB patients were younger, were more commonly underweight, and had more severe dystonia, though no difference between groups was significant. Ten patients (36%) experienced complications in the IVB group, and 14 (45%) in the ITB group. Kaplan-Meier survival analysis showed an odds ratio of 0.816 (95% CI 0.362-1.84, p=0.624) in favor of IVB. Adjusting for age and underweight status yielded an odds ratio of 0.727 (95% CI 0.269-1.964, p=0.530) in favor of IVB. There were 7 catheter or leak-related complications in the ITB group and 2 in the IVB group (p=0.294).

Conclusions: Intraventricular baclofen is as safe as intrathecal baclofen. There may be a lower risk of catheter or leak-related complications with IVB, though this study was too small to show significance.

64. Dosimetry of 124I-8h9 Convection-Enhanced Delivery for Potential Therapy in Diffuse Intrinsic Pontine Glioma

Neal Luther, MD; Zhiping Zhou, MD; Pat Zanzonico, PhD; Nai-Kong Cheung, MD, PhD; John Humm, PhD (New York, NY)

Introduction: Diffuse intrinsic pontine glioma (DIPG) is a logical candidate for local convection-enhanced delivery (CED)-mediated therapy. No human study has directly evaluated dosimetry of CED-infused agents in the brain. This remains a major limitation of this therapeutic modality, as reasons for inefficacy in prior glioma CED clinical trials remain unclear. Because 124I activity in tissue can be directly measured with high resolution via positron-emission tomography (PET), and given the radiation responsiveness of DIPG, 124I conjugated to the anti-glioma monoclonal antibody 8H9 produces a theoretically "theragnostic" agent. CED of 124I-8H9 is a pragmatic novel approach to the treatment of this incurable tumor.

Methods: Pre-clinical experiments evaluating safety and PET imaging following 124I-8H9 CED in rodents and primate were performed. Six adult rats underwent CED of 10 ·Ci of 124I-8H9 to the pons. For dosimetry analysis, PET imaging was performed immediately following CED, and then daily for one week. One primate underwent CED of 1.0 mCi of 124I-8H9 to the pons. PET was performed 1 and 36 hours following surgery, blood and CSF were collected for 124I activity 10 days following CED.

Results: PET dosimetry analysis in rats who underwent 124I-8H9 CED yielded a pontine biologically-absorbed radiation dose of 37 6 Gy/mCi, with >95% of activity cleared within 72 hours. In the primate, PET imaging demonstrated accurate anatomical distribution of 124I activity and dosimetry of the radioisotope.

Conclusion: These results demonstrate the feasibility of in vivo 124I dosimetry measurement via PET, and function to lay the pre-clinical framework of a trial evaluating 124I-8H9 CED in DIPG.

65. Effective Treatment of Disseminated Medulloblastoma with Modified Measles Virus in a Murine Model

Corey Raffel, MD, PhD; Adam Studebaker, PhD (Columbus, OH)

Introduction: Disseminated medulloblastoma in the cerebrospinal fluid is present in 20% of patients at presentation and 40% of patients at recurrence. CSF dissemination carries a grave prognosis with less than 20% of patients surviving 5 years. Effective new treatments for dissemination are needed. We present here our results in treating a xenograft model of disseminated medulloblastoma with modified measles virus. We demonstrate statistically increased survival in animals treated with the virus.

Methods: Nude mice were injected with 10E6 D283MED medulloblastoma cells stereotaxically into the lateral ventricle. The cells were transfected with a luciferase expression cassette to allow monitoring of tumor with imaging. Three days later, measles virus (2x10E5 pfu) was injected in to the lateral ventricle every other day for 5 treatments. Animals were followed with serial biolumuminescent imaging. Survival was determined for treated and control animals. Autopsies were performed on animals showing signs of progressive disease.

Results: Tumor in the spinal canal was detected in all animals by imaging. Untreated mice died in an average of 37 days. Survival in the treated animals averaged 82 days, p=0.0004. Tumors either stabilized or shrank in treated animals, but tumors eventually progressed in all but one treated animal. This one animal, of 8 treated animals, appears to have been cured of disseminated disease. Autopsy revealed extensive intraventricular, intracranial subarachnoid, and spinal subacrachnoid disease in untreated animals. Treated animals that died of progressive disease had similar findings.
Conclusions: We have demonstrated effective treatment of disseminated medulloblastoma with measles virus in a new murine model of CSF dissemination.

66. Management of Diffuse Intrinsic Pontine Glioma: Results of a Practice Survey

Michael H. Handler, MD; Nicholas K. Foreman, MB (Aurora, CO)

Introduction: Diffuse intrinsic pontine gliomas (DIPG) have not undergone routine biopsy, after studies demonstrated little clinical benefit. This survey was undertaken to assess differences in criteria for biopsy among neurosurgeons.
Methods: Records of The Children's Hospital of Colorado brain tumor program were reviewed for patients with a DIPG . We chose a range of cases to reflect a spectrum of "typicality" by imaging. A survey assembling 16 cases was prepared, asking for an assessment of "typicality"' and querying the necessity to biopsy. It was sent to e-mail addresses of members of the ASPN and Pediatric Section.
Results: Surveys were received by 269 individuals, 88 (33%) of whom completed it. No tumor was universally judged to be "typical" or "atypical," though consensus of greater than 90% was noted for 3. Each tumor had several surgeons who would biopsy. Willingness to biopsy increased as increasing numbers judged a tumor atypical. For tumors not clearly typical or atypical by consensus, there was considerable variability regarding need to biopsy. Transcerebellar biopsy was favored, though for certain tumors, a significant number would perform open biopsy, and some would resect more widely. 75% of surgeons would biopsy as part of a national protocol.
Conclusion: There is variation among practicing pediatric neurosurgeons in defining a "typical" diffuse intrinsic pontine glioma, and in deciding when to biopsy . This could call into question whether, in real practice, there is a uniform standard of care in the treatment of DIPGs. A well-conceived research protocol mandating biopsy of "typical" DIPGs might have wide acceptance.

67. Radiographic Features Which Predict Lack of Complete Response to Chemotherapy in Pediatric Intracranial Germinomas

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Introduction: Current management of intracranial germinomas in children consists of upfront chemotherapy followed by reduced dosage of radiation therapy where indicated. Residual radiographic disease after the initial sequence of chemotherapy often necessitates "second-look surgery", to rule-out persistent non-germinomatous elements. The present study aims to evaluate radiographic features present at the time of initial diagnosis which might predict the need for"second-look surgery." Such high-risk features might lead to alternate management of these patients.
Methods: An IRB-approved retrospective review was performed on all patients treated for intracranial germinoma at a major children's hospital over an 8year period. Patients charts and all radiographic studies were reviewed in their entirety. MRIs and CTs were evaluated for tumor location, tumor size, calcifications, cysts, heterogeneity of enhancement, and invasiveness.
Results: 30 patients with histologically confirmed germinomas were identified. 67%were male and 33%were female. Average time to follow-up was 4.3years. The average age at diagnosis was 13.3years. 9(2 females, 7 males) required second look surgery within the first year of their diagnosis. At the time of second look surgery,1 patient had residual germinoma,2 had gliosis,3 had teratomatous features,and 3 had mixed malignant germ cell tumors. Pearson Chi-Square statistical analysis was performed to compare all germinomas with and without second surgeries. Calcification was associated with a need for second-look surgery($p = 0.034$). Heterogeneity of enhancement correlated with persistent disease but did not reach statistical significance ($p = 0.057$). Tumor location, tumor size,tumor invasiveness,and cyst presence did not impact on the need for second-look surgery.
Conclusions: Focal calcifications and possibly heterogeneous enhancement may predict which germinomas will require second-look surgery.

68. Focal Brain Stem Gliomas

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Introduction: Focal brain stem gliomas are an uncommon entity, presumed to have a good prognosis that require various surgical and treatment strategies.
Methods: The authors have reviewed the St. Jude data base from 1985 to 2008 and report on 44 biopsy proven low grade gliomas - the largest reported biopsy proven series.
Results: This review resulted in a novel anatomic classification of these tumors. Surprisingly analysis of the subgroups revealed that the majority had an excellent quality of life with greater than 97% 5 year survival. One subgroup had a survival of only 69%. (follow up 1-12 years).
Conclusions: This anatomical classification of focal brain stem tumors will be discussed along with the different surgical strategies utilized based on anatomical location. The clinical presentation, surgical approach, degree of resection, complications of surgery and quality of life data will be presented.

69. Congenital Glioblastoma Multiformas: A Retrospective Review

Alya Hasan, MD, FRCSC; Margaret Macy, MD; Bette Kleinschmidt-DeMasters, MD; Nicholas Foreman, MD; Andrew Donson, BS; Michael Handler, MD, FACS (Denver, CO)

Introduction: Congenital glioblatomas multiformae (cGBM) occur in the first 3 months of life, the third most common congenital brain tumor. Historically, their prognosis has been considered to be poor. Genetically, GBMs in older children have lower frequency of EGFR amplification, PTEN mutations & p16 (CDKN2A) and P14ARF deletions than their adult counterparts.
Methods: 6 patients with cGBM have been treated at The Children's Hospital of Colorado. The clinical presentation, surgical intervention, chemotherapy, outcome (clinical & radiological), were documented. Genetic expression profiling was reviewed in 3/ 6 cases, and then validated with immuno-histochemistry.
Results: Tumors presented after progressive macrocephaly, symptoms suggesting elevated intracranial pressure, or incidentally. Surgical treatment (biopsy to near total resection) was followed by chemotherapy (Carboplatin and Etopside) every 21 days, up to 6 cycles. There was a surgical mortality, but the remaining 5/6 are alive, with a median survival of 21 m. Extent of surgical resection does not correlate to longer survival. In a clustering analysis of gene expression profiles, cGBM form a distinct subgroup within high grade gliomas, suggesting they differ from their pediatric & adult counterparts. Unique molecular features were over-expression of multiple genes involved in CNS development, e.g. homeobox genes.
Conclusions: cGBMs have a better prognosis than in older patients. The over-expression of genes involved in development of the CNS suggests that the aggressive course of these tumors seen in older individuals may be attenuated by the recapitulation of normal developmental pathways. The genetic dissimilarities appear to correspond to a much longer survival in this very young group.

ORAL ABSTRACTS

70. Differentiating Brain Tumor Progression from Pseudoprogression in Children Using Ferumoxytol, A Novel Magnetic Resonance Imaging Contrast Agent

Daniel J. Guillaume, MD, MSc; Eric Thompson, MD; Edit Dosa, MD; Kellie Nazemi, MD; Edward E. Neuwelt, MD (Portland, OR)

Introduction: Differentiating tumor progression from pseudoprogression (imaging changes occuring from radiochemotherapy) is important but difficult using conventional MRI. Ferumoxytol, an ultrasmall superparamagnetic iron oxide nanoparticle, is a novel MRI contrast agent. Until now, it has not been studied in children. The purpose of this National Cancer Institute sponsored prospective study is to characterize the vascular properties of pediatric brain tumors using ferumoxytol. Here we report patients in whom ferumoxytol was used to differentiate tumor progression from pseudoprogression.

Methods: In a single imaging session, ferumoxytol (2 or 4 mg/kg intravenously) was administered for dynamic susceptibility-weighted contrast (DSC) MRI, followed by gadolinium (0.1 mmol/kg) for conventional contrast-enhanced MRI. From the DSC data, lesional relative cerebral blood volume (rCBV) and cerebral blood flow (rCBF) were calculated.

Results: In four subjects with high-grade tumors (medulloblastoma, anaplastic oligoastrocytoma, anaplastic astrocytoma and glioblastoma multiforme), ferumoxytol DSC MRI was used to help differentiate tumor progression from pseudoprogression. All subjects, previously treated with surgery, radiation and chemotherapy, demonstrated enhancement progression on post-gadolinium MRI. In three cases, rCBV was < 1 despite increased gadolinium enhancement, suggesting radiochemotherapy-induced pseudoprogression. Vascular maps in one patient were indeterminate secondary to proximity to major arteries. None of the patients required biopsy to rule out progression, and no lesions have progressed.

Conclusion: rCBV and rCBF determined by DSC MRI using ferumoxytol has the potential to differentiate pseudoprogression from tumor progression. The potential of ferumoxytol, as a contrast agent for imaging brain tumors deserves further study in the pediatric population.

71. Intracranial Tumours in Infants: Long Term Quality of Life and its Predictors

Mary Metrie, BS; Shibu Pillai, MD; Paul Steinbok, MD, FRCS; Doug Cochrane, MD, FRCS; Ashutosh Singhal, MD, FRCS; Juliette Hukin, MD; Michael Sargent, MD; Christopher Dunham, MD (Canada, Vancouver)

Introduction: Introduction: Intracranial tumors are rare in the first year of life. The epidemiology and survival rates have been well reported, but literature on the long-term quality of life of survivors is scant. This study evaluates quality of life of survivors at least 5 years after diagnosis and the predictors of this outcome.

Methods: Retrospective chart review of all children less than 1 year of age diagnosed to have an intracranial tumor from 1982 to 2005 at a tertiary care children's hospital. Outcome was assessed at 5 years or more using Bloom's categories and LESS Scoring. Active children capable of self-care (Bloom1-2) were categorized as good outcome and all others as poor outcome. Age, tumor location, size, radiology, management, and WHO grade were evaluated as predictors of outcome using t-test, chi-square test and logistic regression analysis. Radiology and pathology were re-reviewed by a pediatric neuroradiologist and neuropathologist respectively.

Results: Among 37 infants, the five-year survival rate was 60%. Good outcomes was noted in 35%, and among the good outcomes 54% had neurological sequelae such as ataxia, hemiparesis or seizures, 30% had mild visual/auditory deficits and 15% an endocrine deficit. Supratentorial location of tumor predicted a better outcome at diagnosis (p=0.05). Of the post-operative factors, high grade pathology (III, IV) predicted poor outcome (p<0.02).

Conclusion: Thirty-five percent of infants with intracranial tumors will have a good quality of life at 5 years. Tumor location and grade best predict quality of life pre-operatively and post-operatively respectively. Tumour grade is the single best predictor of survival.

72. Neoadjuvant Chemotherapy Reduces Vascularity and Permits Safe Resection in Infantile Vascular Neoplasms

Mark Van Poppel, MD; Paul Klimo, MD; Mariko Dewire, MD; Karen Wright, MD; Thomas Merchant, MD; David Ellison, MD; Robert Sanford, MD; Amar Gajjar, MD; Frederick Boop, MD (Memphis, TN)

Introduction: Infants with high grade neoplasms are at risk to exsanguinate during tumor resection. Neoadjuvant chemotherapy may reduce tumor vascularity and facilitate a gross total resection at second craniotomy. The authors report 13 infants treated prospectively with chemotherapy after initial biopsy or subtotal resection with the anticipated intent of reducing surgical blood loss during future procedures. Repeat surgery permitted aggressive resection of their tumors with acceptable blood loss.

Methods: Thirteen infants (4 female, 9 male) ranging from birth to 3 years old were enrolled in an institutional protocol in which they were treated with biopsy or partial resection followed by multi-agent chemotherapy and second look surgery. Chemotherapy included methotrexate, vincristine, cis-platin and cyclophosphamide.

Results: Initial surgery included a biopsy in 3 infants and a subtotal resection in 9 infants. Pathologies included 5 ependymomas, 2 malignant gliomas, 2 ATRT (Atypical Teratoid Rhabdoid Teratoma), and 4 rare pathologies. Chemotherapy varied from one to four courses. Serious adverse events were acceptable. Upon further surgery 10/13 had a gross total resection, 2/13 had a near total resection defined by <1.5 cc residual tumor, and one had a subtotal resection. In each case, a marked reduction in tumor vascularity was appreciated. Upon follow up, two have died, two developed progressive disease and nine have no evidence of disease.

Conclusions: Gross total resection of pediatric brain tumors is the most important predictor of outcome. In infants with a variety of malignant tumors, neoadjuvant chemotherapy is well tolerated, reduces vascularity significantly, and subsequently facilitates a gross total resection.

73. The Management of Spinal Aneurysmal Bone Cysts

Georgios A. Zenonos, MD; Lance Governale, MD; Osama Jamil, MD; Sarah Jernigan, MD; Mark Proctor, MD (Boston, MA)

Introduction: Spinal aneurysmal bone cysts(ABC) constitute a clinically challenging disease, primarily affecting the pediatric population. Information regarding their management remains sparse. In this study we review the experience with spinal ABC at Children's Hospital Boston.

Methods: The medical records of all patients treated surgically for primary spinal ABC from January,1998 to July,2010 were retrospectively reviewed.

Results: Fourteen-cases were identified(6M, 8F ages 5-19). Location: 2(14%)cervical spine; 6(42%)thoracic spine; 6(42%)lumbar spine. Presentation: 13(93%)back pain; 4(28%)deformity; 5(36%)neurologic deficits; 1(7%)asymptomatic. Diagnosis:Pre-operative evaluation was performed with a combination of plain X-rays, CT and MRI. One(7%)case underwent a CT-guided needle biopsy. Two(14.2%)cases were identified as solid-variants. Six(42.8%)had significant cord compression; 3(21.4%) significant nerve-root-compression; 4(28.5%)were associated with vertebra plana. Treatment:Pre-operative selective arterial embolization(SAE) was performed in 7(50%)cases. Eleven(79%)cases underwent a wide gross total excision and 3(21.4%) intralesional curettage. Thirteen(92.8%)cases underwent spinal stabilization. Mean follow-up was 55.6 months(range:15-154) after initial intervention. Two(14%)ABC recurred, at 9 months and 8 years after incomplete initial resection, and underwent reoperation. Complete resection was ultimately achieved in all cases. All patients were asymptomatic and neurologically intact at their last follow-up and had no evidence of deformity or recurrence.

Conclusions: CT and MRI are adequate for an initial evaluation of spinal ABC, although solid variants can present a diagnostic challenge. Preoperative SAE is often performed, although the degree of intra-operative bleeding tends not to support it's routine use. Although long follow-up is warranted as recurrences can occur years after initial intervention, gross total excision, in conjunction with spinal stabilization as needed, usually provides cure of the ABC and excellent long-term spinal alignment.

74. Proteomic Analysis of Cerebral Spinal Fluid From Children with Brainstem Glioma

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Introduction: Brainstem gliomas (BSGs) constitute 15% of pediatric brain tumors. Of these, 80% are diffuse intrinsic pontine gliomas (DIPGs). DIPG is the leading cause of brain tumor death in children, and no effective treatment exists. The location and infiltrative nature of BSGs often preclude surgical resection, and biopsy is rarely performed. This limits tissue available for molecular studies and hence understanding of tumor biology. We therefore aimed to analyze the protein profile of cerebrospinal fluid (CSF) from BSG patients to facilitate discovery of tumor biomarkers and elucidate tumorigenic pathways. Here, we present the results of the first proteomic analysis of CSF specimens (n=9) from children with BSG and DIPG.
Methods: CSF from patients with BSG was compared to healthy controls and non-brainstem tumors using SDS-PAGE 2D gel electrophoresis, followed by in-gel tryptic digestion and MS/MS quantitative proteomic analysis using LTQ-Orbitrap-XL. Isolated peptides were identified using the Sequest algorithm in the Bioworks browser against the Uniprot database. Protein and pathway analysis was performed with ProteoIQ and Ingenuity Pathway Analysis software, respectively.
Results: A total of 422 proteins were identified, of which 92 showed differential expression levels (> 2; <-2 fold change) in tumor samples compared with controls. Dysregulated proteins were mapped to known pathways of glioma formation, cell migration, or response to oxidative stress.
Conclusions: We have generated the first comprehensive protein profile of BSG and DIPG CSF specimens. Further evaluation and tissue validation is underway. Proteomic analysis of CSF from children with BSG offers a systematic approach to understand tumor formation and identify unique biomarkers.

75. Selective Dorsal Rhizotomy: Somatotopic Organization of Sensory Nerve Rootlets

Victor L. Perry, MD; Crystal Adams (Chapel Hill, NC)

Introduction: Selective dorsal rhizotomy is a surgical procedure that effectively treats hypertonicity in children with spastic diplegia. This study describes the surgical technique refinement developed at UNC Chapel Hill and analyzes standard outcome measures for the 3 year UNC case series of SDR patients. An additional aim of this study was to describe the preliminary and novel finding of characteristic location of abnormally spastic rootlets within the dorsal sensory root.
Methods: 25 patients with spastic diplegia undergoing SDR at UNC were analyzed. Standard surgical technique of SDR via multilevel osteoplastic laminotomy was carried out on all patients. All patients tolerated surgery well with no postoperative complications. In addition, the five most recent patients underwent the standard procedure, but with localization and documentation of the orientation of rootlets at each level. Standard outcome measures were utilized in analyzing this cohort of patients.
Results: All patients tolerated the procedure well with no postoperative complications. All had significant improvement in their spasticity. In addition, in 5 patients in whom orientation of the hypertonic rootlets was documented, it was noted that the most abnormal rootlets tested and sectioned were typically located lateral-most.
Conclusions: We believe that this study will increase the knowledge and understanding of the pathophysiology and treatment of spastic diplegia in children. We expect that the results of this study will lead to further investigation regarding the refinement of the SDR surgical technique. We also hope this study will lead to investigations analyzing the location and characteristics of hypertonic rootlets within the dorsal sensory root.

76. Deep Brain Stimulation (DBS) for Childhood Dystonia with the Frameless Stereotactic System: Operative Experience and Accuracy

Daniel Curry, MD; Akash Patel, MD; Amber Stocco, MD; Aloysia Schwabe, MD; Robert Dauser, MD; Andrew Jea, MD; William Whitehead, MD; Thomas Luerssen, MD; Daniel Curry, MD (Houston, TX)

Introduction: Dystonia is a debilitating movement disorder that causes functional deficits, pain, and orthopedic deformity. Although some varieties are genetic, a significant portion of pediatric dystonia cases are from injury to the developing brain and are frequently coexistent with cerebral palsy. Deep Brain Stimulation is an emerging treatment in childhood dystonia, however frame-based systems and stereotactic brain atlases are difficult to apply to children with smaller, more abnormal anatomy. Frame-base systems also risk skull fractures and minimize the child's cooperation with the procedure. We report our experience with the frameless approach in pediatric DBS.
Methods: 5 children, ages 8-16, with dystonia underwent stereotactic placement of DBS electrodes with the frameless stereotactic system. The system utilized in-bone fiducials and a burr-hole based disposable frame. Targets included bilateral Globus Pallidus Internus (GPI) in 3 patients, unilateral GPI in one patient, and unilateral Subthalamic Nucleus (STN) in another patient. All patients underwent post-op thin-cut CTs that were fused to the pre-op MRI to assess accuracy.
Results: All 5 children tolerated the procedure well with Dexmedetomidine and Ketamine anesthesia combined with local blockade. The wakefulness of the patient optimized microelectrode recording, and the patients were able to cooperate with intraoperative physiologic testing. Electrodes were accurately placed in the target in all patients.
Conclusion: Frameless stereotactic DBS electrode placement, with microelectrode recording in the awake patient, is a feasible and physiologically optimal technique for electrode placement in children with distorted basal ganglia anatomy. The technique is well tolerated and accurate.

77. Surgical Treatment of Pediatric Trigeminal Neuralgia with Microvascular Decompression

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Introduction: Pediatric trigeminal neuralgia (TGN) is a rare entity. The purpose of this study was to retrospectively analyze a small series of pediatric patients diagnosed with TGN and surgically treated with microvascular decompression (MVD).
Methods: Nine patients were identified who presented with TGN symptoms that began before the age of 18. Four were excluded because of delayed surgical intervention or successful medical management. There were 5 patients with classical TGN who underwent MVD at or before the age of 18. These patients' charts were reviewed retrospectively.
Results: Patient ages ranged from 3 to 18 at the time of procedure, with an average of 11.7 years. All 5 patients were female. Three patients had right-sided pain, 1 left-sided, and 1 bilateral. Four patients underwent a single procedure and 1 had bilateral MVDs. In all 6 cases, vascular compression of the trigeminal nerve was found during surgery. In 3 cases, compression was venous, in 2 it was arterial, and in 1 both were present. Pain relief was complete following the procedure in 5 of 6 cases. One patient had no pain and is still tapering medications. Follow-up duration ranges from 23 to 504 days with median of 75 days. There were no serious complications.
Conclusion: Until now, there had been no reports on the effectiveness of MVD performed before the age of 18 to treat TGN. These preliminary results suggest MVD may be performed with good pain relief and minimal side effects in the pediatric population.

78. Amenorrhea Complicating Endoscopic Third Ventriculostomy in Children: Case Report and Review of the Literature

Steven W. Hwang, MD; William E. Whitehead, MD; Daniel J. Curry, MD; Thomas G. Luerssen, MD; Andrew Jea, MD (Houston, TX)

Introduction: Endoscopic third ventriculostomy (ETV) is an accepted option in the treatment of obstructive hydrocephalus in children and is considered by many pediatric neurosurgeons to be the treatment of choice in this patient population. The procedure involves perforation of the floor of the third ventricle, the tuber cinereum, which is part of the hypothalamic-pituitary axis of cerebral endocrine regulation. Endocrine dysfunction, such as amenorrhea, weight gain, and precocious puberty, which are recognized only months to years after the procedure, may be underreported because patients and physicians may not relate the endocrine sequelae to ETV.
Methods: We retrospectively reviewed our series of 46 patients having undergone ETV for obstructive hydrocephalus from January 1, 2007 to June 30, 2010 to identify which patients had postoperative endocrinopathy and reviewed associated laboratory values.
Results: We identified 2 patients with reported amenorrhea or dysmenorrhea after ETV. One patient had concurrent weight-gain, hyperhydrosis, and subjectively reported increased anger by the parents; the second patient had no other associated symptoms. We noted the presence of slightly low estrogen and progesterone, as well as a borderline elevated prolactin level.
Conclusion: Few detailed reports of endocrine-related complications after ETV exist to better understand these issues. In this study, we add to the literature with case descriptions of 2 adolescent girls who underwent ETV for obstructive hydrocephalus, and subsequently developed amenorrhea with correlative laboratory findings.

79. Fenestration of Lumbar Thecal Sac Can Prevent the Need for Ventriculoperitoneal Shunting in Post-Operative Pediatric Patients

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Introduction: Communicating hydrocephalus occurs in a large percentage of pediatric patients undergoing intracranial surgery, most notably tumor resection. These patients frequently require additional surgery for diversion of cerebrospinal fluid. We describe a technique that may eliminate the need for cerebrospinal fluid (CSF) diversion surgery in this patient population using lumbar dural fenestration.
Methods: We performed a retrospective chart review from 2005 to 2009 of all pediatric patients undergoing a large-volume lumbar puncture and dural fenestration for the treatment of communicating hydrocephalus after treatment of intracranial tumors, arteriovenous malformations (AVMs), aqueductal stenosis and post-hemorrhagic hydrocephalus.
Results: A total of 21 patients met criteria for review. The average patient age was 7 years [5 months to 18 years]. Patient diagnoses included 16 tumor, 2 ruptured AVM, and 1 patient each with aqueductal stenosis, ruptured arachnoid cyst and post-hemorrhagic hydrocephalus. 71% of the patients (15/21) were treated successfully with lumbar fenestration; 100% of patients older than 3 years (11 patients) had successful treatment. Of the successfully treated patients 36% (4/11) required two fenestrations; 18% (2/11) required three.
Conclusion: Surgery for CSF diversion may be avoided in pediatric patients undergoing intracranial tumor resections using high-volume lumbar puncture and subsequent fenestration of lumbar thecal sac dura. This technique has been particularly successful in children older than 3 years of age and may also be useful for diagnoses other than tumor.

80. Therapeutic Target B7-H3 is Expressed in Pediatric Diffuse Intrinsic Pontine Glioma

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Introduction: Limitations in molecular characterization of diffuse intrinsic pontine glioma (DIPG) in children continue to pose a challenge in the development of novel tumor-targeted therapies against this incurable tumor. Membrane protein B7-H3, involved in interactions with host defenses, has been shown to be over-expressed in numerous cancers, e.g., it is highly expressed in prostate cancer and associated with disease spread and poor outcome. B7-H3 is over-expressed in the majority of adult high-grade glioma. Intrathecal anti-B7-H3 monoclonal antibody 8H9 conjugated to I-131 has shown success in the treatment of stage IV childhood neuroblastoma, another neuroectodermal tumor. It thus stands to reason that B7-H3 could serve as a therapeutic target in DIPG.
Methods: Immunohistochemistry (IHC) of 33 high- and low-grade brain stem glioma samples was performed to determine B7-H3 expression rates. In addition, microarray analysis of three DIPG tumor specimens was performed to evaluate RNA levels of B7-H3.
Results: Thirteen of the 33 specimens for IHC were classified as DIPG and 20 were of low-grade pathology. Twelve DIPG (92%) and four low-grade specimens (20%) were stained positive for B7-H3. The association between histological grade and B7-H3 immunostaining was statistically significant ($p<0.0001$). Microarray analysis showed increased RNA levels of B7-H3 in DIPG compared to normal brain and juvenile pilocytic astrocytoma.
Conclusions: B7-H3 is over-expressed in pediatric DIPG. Given the need for novel treatment in this disease, and the success of 8H9 therapy in stage IV neuroblastoma, anti-B7-H3 therapy is a plausible therapeutic strategy in DIPG.

81. Acquired Chiari I Malformation of Infancy

James E. Messegee, BS; Alan Cohen, MD; Shenandoah Robinson, MD (Cleveland, OH)

Introduction: The Chiari I malformation (CMI) is characterized primarily by cerebellar tonsillar herniation. Most cases are congenital. Infrequently, symptomatic acquired CMIs have been described following interventions such as lumboperitoneal shunting. We report three patients who developed symptomatic acquired CMIs in infancy.
Methods: Following IRB approval, the records of three term infants who developed acquired CMIs were reviewed. MRIs were analyzed by an observer blinded to patient status, who measured clival and tentorial angles to assess posterior fossa geometry. MRIs of the 3 index cases were analyzed, along with scans of 24 normal term infants, 15 term infants with VP shunts, 5 preterm infants, 8 preterm infants with VP shunts, 5 infants with occult spinal dysraphism and 10 infants with Chiari II malformations (CMII).
Results: The three index patients underwent MRI examination because of neurological dysfunction. None had evidence of CMI on the initial exam. Two experienced prenatal drug exposure, one of whom had microcephaly. Two had hydrocephalus and underwent VP shunting. Each developed a symptomatic CMI several months later in the setting of a functioning shunt. The microcephalic child developed a symptomatic CMI with 20 mm of cerebellar tonsillar descent. Two of the index cases had posterior fossa geometries seen with CMII, with tentorial angles greater than clival angles.
Conclusions: Symptomatic acquired CMI in infancy may be a consequence of altered posterior fossa geometry and development. CMI may be an infrequent consequence of VP shunting. Foramen magnum decompression can lead to symptomatic improvement.

POSTER ABSTRACTS

82. Justification of Empiric Vancomycin Utilization for the Treatment of CSF Shunt Infections

Jeffrey P. Blount, MD; Chevis N. Shannon, PhD; Ashley C. Westrick, BS; Joshua J. Chern, MD, PhD; John J. Wellons, MD; Curtis J. Rozelle, MD; Richard S. Tubbs, PhD, PA-C; Jerry Oakes, MD (Birmingham, AL)

Introduction: Standardized quality assurance and patient safety parameters have been developed for pediatric medical centers. One important benchmark is Vancomycin usage. At our institution Pediatric Neurosurgery was identified for disproportionate use of Vancomycin. The purpose of this study was to review whether empiric Vancomycin was justified in the setting of possible CSF shunt infection.

Methods: We retrospectively reviewed positive ventricular CSF cultures between 2005 and 2008 with respect to antibiotic sensitivity profiles. We focused on aerobic Staphylococcal infections and calculated sensitivities for Staph aureus and the Coagulase Negative Staphylococci (CNS).

Results: There were 128 ventricular CSF Staphylococcal infections identified. Thirty one anaerobic specimens were excluded leaving 97 total positive specimens. There were 36 positive specimens in 16 patients for Staphylococcus aureus and 61 specimens in 44 patients for the CNS. Observed resistances for Staph aureus were Oxacillin 28%, Clindamycin 11%, Cefazolin 42% and 0% for Vancomycin, Tetracycline, TMP and Rifampin. Observed resistances for CNS were Oxacillin 64%, Rifampin 9.5%, TMP 31%, Tetracycline 22%, Cefazolin 59% and Vancomycin 4.6%. For the same time period hospital wide sensitivity to Staph aureus was 100% for Vancomycin, 94% for Tetracycline, 86% for TMP, 84% for Gentamycin and 73% for Rifampin.

Conclusion: Since nearly one third of all positive Staph aureus and two thirds of all CNS were Oxacillin resistant short term empiric utilization of Vancomycin appears justified. Reductions in overall utilization are likely best realized by narrowing the antimicrobial spectrum once sensitivity and species are realized.

83. Use of the Periumbilical Incision for Peritoneal Access in Ventriculoperitoneal Shunt Placement: Long-Term Results

Pablo F. Recinos, MD; Shaan M. Raza, MD; Mazen I. Bedri, MD; Edward S. Ahn, MD; Benjamin S. Carson, MD; George I. Jallo, MD (Baltimore, MD); Violette Renard Recinos, MD (Cleveland, OH)

Introduction: A standard surgical treatment of hydrocephalus is placement of a ventriculoperitoneal (VP) shunt. The distal VP shunt catheter is commonly inserted via a mini-laparotomy. The abdominal incision commonly used to make the laparotomy during VP shunt placement can result in poor cosmesis and long-term morbidity.

Methods: A periumbilical approach was utilized in nineteen patients (males = 7, females = 12). for distal catheter insertion during first-time VP shunt placement. The incision was made along the natural crease inferior to the umbilicus. Age at time of surgery was noted (range = 3 days - 11.9 years, median = 97 days) and the patients were subsequently followed for complication development.

Results: During the follow-up period (Mean = 140 days, Median = 116 days), four patients required operative intervention (1 proximal revision, 2 distal revisions, and 1 removal/replacement of entire VP shunt system). There was one shunt infection requiring removal of the shunt system with delayed replacement post antibiotics. Distal failures related to the periumbilical approach were not observed.

Conclusions: The periumbilical incision for peritoneal access in VP shunt placement is cosmetically favorable and carried no additional risk in long-term follow-up. It may be considered as an alternate technique to the standard mini-laparotomy for distal catheter placement in patients undergoing initial VP shunt placement.

84. Modification of Intracranial Pressure - Reduction of Ventricular Catheter Blockage in Hydrocephalus

Robert F. Jones, FRCS, FRACS (Paddington, Australia)

Introduction: Prior to 1978, we had problems due to recurrent blockage of ventricular catheters. So we stated using Portnoy's AntiSiphon Device in 1978. We also performed Endoscopic Third Ventriculostomy in preference to shunt revision. The preliminary results were presented at a Symposium on Hydrocephalus in Kobe November 1990 and are as follows.

Methods: An increase in ventricular size was demonstrated in 34 of 37 patients. At times, more than one operation was needed so there were 49 revision operations. The ventricular size was confirmed independently by our radiologist, V Nayanar. Up to half of the children suffered headache and vomiting for up to 3 days despite a functioning shunt. One required reduction of a high pressure valve to a medium pressure one.

Results: The result was that currently blockage of the distal catheter twice as common in our unit than the ventricular. Also the average duration of function after placement of a suitable pressure system is some 8 years. This excludes re-operation due to infection (RJ's incidence 2 1/2%). This is in contrast to the Canadian experience (Drake). It is also in contrast to Adelson's survey of North American Centers.

Conclusions: My explanation is that the crucial importance of freely patent catheters is not always appreciated as is the necessity for free transmission of atmospheric pressure to the diaphragm of the AntiSiphon Device. The Siphon Control Device has less anti-siphon activity but is more tolerant of partial catheter blockage. Other shunts, e.g. gravitational, have shown promise since I retired in 1998.

85. Serial CSF Sampling from Ventriculostomies Increases the Risk of Infections

David Bauer, MD; Daxa Patel, MD; Chevis Shannon, MD; Jeffery Blount, MD (Birmingham, AL)

Introduction: Routine management of shunt infections consists of shunt removal, ventriculostomy placement, intravenous antibiotics, and serial cerebrospinal fluid (CSF) sampling to determine when the CSF is sterile for placement of a new shunt. Previous studies have suggested that routine CSF sampling is unnecessary and may increase the risk of ventriculostomy infections. The purpose of our study was to review previous shunt infections and determine the infection rate of ventriculostomies in our patient population.

Methods: A retrospective medical record review was performed of patients treated for shunt infection between January 2008 and December 2009 at the Children's Hospital of Alabama. Patients who underwent shunt removal and ventriculostomy placement due to a positive CSF culture and had 6 months of follow up data were included in the study.

Results: 343 patients accounting for 583 shunt procedures were identified. Of those 583 procedures, 27 were new shunts post infection. 4.5% of new shunts and 6.9% of shunt revisions became infected. 7.3% of patients who received a shunt after an initial ventriculostomy developed an infection. The most common organisms identified were staph epidermidis, staph aureus, klebsiella pneumoniae, and serratia marcescens. Two patients admitted for shunt infection developed new ventriculostomy infection with a different organism after initial sterilization of CSF.

Conclusions: This study lends evidence that ventriculostomy is a risk factor for shunt infection. Given the organisms identified, there is evidence to suggest that these infections may be introduced during CSF sampling. We plan to prospectively evaluate the utility and risk of serial CSF sampling.

POSTER ABSTRACTS

86. Predicting Outcomes for Endoscopic Third Ventriculostomy: A Validation of the ETV Success Score

Luigi Bassani, MD; David Hersh, BA; Howard Weiner, MD; Jeffery Wisoff, MD; David Harter, MD (New York, NY)

Introduction: Hydrocephalus is traditionally treated with a cerebrospinal fluid shunt. This method is linked to potential complications including infection, malfunction and over-drainage. Endoscopic third ventriculostomy (ETV) is an alternative treatment for hydrocephalus. Recently, an ETV Success Score was devised to predict ETV probability in treating hydrocephalus. We sought to valid this score in predicting ETV outcomes.
Methods: A retrospective review was performed of 60 patients who underwent ETV between January 2005 and February 2010. Age, cause of hydrocephalus, presence of a previous shunt, and outcome at 6 months were evaluated. ETV failure was defined as a second surgical procedure for hydrocephalus or death related to hydrocephalus within 6 months of the ETV
Results: Sixty patients were identified who underwent ETV by 3 neurosurgeons over a 5 year period, mean age 17 years (range: 2 months to 83 years). Fifty-three patients (88.3%) did not have a previous shunt. Overall, 42 patients (70%) had successful ETVs at 6 months. Of the 51 patients (85%) with an estimated ETV success score of 70-90 (high chance of success), 35 (68.6%) had a successful ETV outcome. Of the 9 patients with a score of 30-60 (moderate chance of success), 7 (77.8%) had a successful ETV. There were no patients with a score of 0-20 (low chance of success).
Conclusions: The ETV Success Score appears to be a valid measure in predicting which patient's will likely benefit from an endoscopic third ventriculostomy, thus potentially avoiding long term complications of cerebrospinal fluid shunt.

87. Axiom Magnetic Neuronavigation for Optimal Shunt Placement and Survival vs. Freehand Placement

Samuel R. Browd, MD, PhD (Seattle, WA); Brent O'Neill, MD (Denver, CO); Michael Levitt, MD; Jeffery Ojemann, MD (Seattle, WA)

Introduction: Frameless magnetic neuronavigation is gaining traction amongst pediatric neurosurgeons for optimal proximal catheter placement. Several small series have suggested improved shunt survival.
Methods: A retrospective review of 100 Axiom magnetic neuronavigation cases will be compared against a historical freehand placement cohort to determine accuracy of proximal catheter placement and shunt survival at 30 days, 90 days and at 6 months.
Results: Our preliminary results demonstrate a high degree of accuracy using Axiom vs. freehand placement with an associated shunt survival advantage.
Conclusions: Rameless magnetic neuronavigation appears to increase targeting accuracy leading to an increase in shunt survival. Quantitative results demonstrating accurate catheter targeting and shunt survival curves will be presented.

88. Neonatal Factors are Associated with Ventriculo Peritoneal Shunt Failure

Chevis N. Shannon, PhD (Birmingham, AL); Russell S. Kirby, PhD (Tampa, FL); Richard S. Tubbs, PhD; Jeffrey P. Blount, MD; Walter J. Oakes, MD; John C. Wellons, MD (Birmingham, AL)

Introduction: Understanding the clinical, neonatal, social and environmental factors associated with shunt failure within a particular subpopulation of patients allows us to better treat and manage our patients. The purpose of this study was to assess the premature patient population and to identify factors associated with initial ventriculo-peritoneal (VP) shunt failure that occurs in the short term.
Methods: A retrospective electronic medical record review was performed of patients, born between the years 2000-2005, initially diagnosed and treated for hydrocephalus at a single institution. Patients were then categorized into etiology of hydrocephalus groups for subanalysis.
Results: Patients born less than 37 weeks gestational age had a 61% probability of having a shunt failure within 3-months of their initial shunt placement. Seventy five percent of the children less than 2kg at the time of their initial shunt insertion experienced a shunt failure. For every unit increase of weight (kg) at initial shunt placement, the likelihood of failure decreased (Spearman's rank coefficient -.336, p=<.0001). For every unit increase of age (in months) at initial shunt placement, the likelihood of failure decreased (Spearman's rank coefficient -.265, p=<.0001). Test for collinearity found weight and age to be unrelated in this analysis.
Conclusion: Many of the findings confirm what other previously conducted survival studies have found. However, the lack of correlation between weight and age when assessing this subgroup of patients suggests the need for further evaluation of the impact these factors have on shunt failure.

89. Treatment of Post-Hemorrhagic Hydrocephalus in the Premature Infant with a Ventricular Access Device

Ashley G. Tian, MD; Susan R. Hintz, MD; Ronald S. Cohen, MD; Michael S. B. Edwards, MD, FACS (Stanford, CA)

Introduction: Intraventricular hemorrhage of prematurity (IVH) is a diagnosis that has become more frequent in recent years. Advances in medical care have led to survival of increasingly premature infants, as well as infants with more complex medical conditions. Treatment with a ventricular access device (VAD) was reported almost 3 decades ago, however, it is unclear how effective this treatment is in the current population of premature infants.
Methods: At our institution, we treat post-hemorrhagic hydrocephalus (PHH) with a VAD. In order to look at safety and efficacy, we retrospectively combed the medical records of premature children, admitted to Lucile Packard Children's Hospital from January 2005 to December 2009, and identified 310 premature children with IVH. Of these, 28 children required treatment for post-hemorrhagic hydrocephalus with a VAD.
Results: After careful review of the data, we found no infections associated with placement of ventricular access devices and a very low rate of other complications, such as need for repositioning (7.41%) or replacement (3.75%).
Conclusion: Our data show that treatment with a VAD is very safe, with few complications and can be used to treat PHH in this very complex population.

90. Does Stable Ventriculomegaly Injure White Matter and Affect Cognition? A Diffusion Tensor Imaging Study

Abhaya V. Kulkarni, MD, PhD; Ruth Donnelly, PhD; Donald Mabbott, PhD; Iffat Shams; Elysa Widjaja, MD (Toronto, Canada)

Introduction: Even after successful surgical treatment of hydrocephalus, children can remain with ventricles ranging from slit-like to persistently enlarged (especially after endoscopic third ventriculostomy [ETV]) . It is not known if children suffer long-term deficits because of persistent ventriculomegaly. Specifically, does stretching and compression of the surrounding white matter tracts result in subtle brain injury and cognitive deficit not seen in those with small ventricles?

Methods: We performed a cross-sectional comparative study of white matter injury (using diffusion tensor imaging [DTI]) and neuropsychological function in children with long-standing, stable, treated hydrocephalus due to aqueductal stenosis. Children were > 8 years old, with previous ETV or shunt, and no recent hydrocephalus surgery (>24 months). We calculated mean diffusivity (MD) and fractional anisotropy (FA) values over several brain regions as well as the ventricular volume index (VVI) (ventricle volume corrected for cerebral volume). Children then underwent detailed neuropsychological testing.

Results: Ten children (mean age 14.7 years, range 9-18) treated with previous ETV (7) or shunt (3) participated. While most DTI measures did not show correlation with VVI, larger VVI was correlated with higher MD (i.e., tissue edema) in the corpus callosum and deep white matter of frontal, parietal, and temporal lobes. Higher VVI was also correlated with lower non-verbal IQ.

Conclusions: Our early data suggests that large ventricles might be associated with some subtle white matter injury, but the relationship to cognitive deficits is not clear. Larger studies are needed to truly assess the impact of ventriculomegaly on cognitive function.

91. Treatment of Very Low Pressure Hydrocephalus

Mark Fedor, MD; Brain Lee, MD; Joffre Oloya, MD; Yasser Jeelani, MD; Mark Krieger, MD; J. Gordon McComb, MD (Los Angeles, CA)

Introduction: Occasionally one encounters the situation where a patient with a normally functioning CSF diverting shunt develops clinical symptoms of shunt malfunction and progressive ventricular enlargement in the face of persistent low or even zero intraventricular pressure (IVP). How does one manage this condition?

Methods: With IRB approval, a retrospective review covering the past ten years at our institution was undertaken to identify those patients who met the above criteria.

Results: Five patients ranging in age from 20 months to 17 years were found. Four patients had posterior fossa tumors and the fifth a cavernous malformation of the 3rd ventricle. All five required CSF diversion following excision of their lesion. The initial treatment was to tap the shunt one or more times a day with removal of increasing volumes of CSF. When that failed an external ventricular drain (EVD) was placed with removal of CSF at a negative IVP up to -20 cm of water. Based upon clinical symptoms and interval imaging for ventricular size the EVD was gradually raised until the outlet pressure was slightly positive (+5 cm of water or even less). At this point, a ventriculo-pleural or ventriculo-peritoneal shunt without a valve was inserted. The entire process extended for weeks or even months but was successful in all five cases.

Conclusions: Treatment of very low pressure hydrocephalus can be very difficult but eventually successful over a protracted period of time. Why the compliance of the parenchyma is temporarily altered is unknown.

92. Pediatric Arteriovenous Malformation: Associated Aneurysms and the Implications for Treatment Paradigms

Caitlin Hoffman, MD; Howard Riina, MD; Philip Stieg, MD, PhD; Baxter Allen, MD; Pierre Gobin, MD; Mark Souweidane, MD (New York, NY)

Introduction: Arteriovenous malformations (AVM) with associated aneurysms (AA) increase hemorrhagic risk in adults. AA are thought to develop over time, and the incidence in children is therefore thought to be minimal. The pediatric incidence has not been studied, however, and our aim is to define the incidence and morbidity of AA in children, and to assess the results of our treatment strategy.

Methods: Patients less than 18 years with pial AVM were reviewed from 2000 to 2009. Demographics, presentation, associated aneurysms, treatment, and outcome were analyzed.

Results: Of 144 patients with AVM, 30 were less than 18 years. AA was identified in 5/30 (16.7%) children and 33/114 (28.9%) adults. (p=0.25) Mean age at presentation was 11.67 years (range 6mo-17yrs), and mean follow up was 21 months (range 1 - 75 months). Hemorrhage at presentation was 80% with AA and 72% with AVM alone. Emergent therapy was required in 60% of patients with AA and 40% with AVM alone (p=0.63). Time to treatment was 4.3 days with AA and 27.3 days without (p=0.42). There was no difference in outcome between patients with AA and AVM alone.

Conclusions: The incidence of pediatric AA was higher in our series than projected in the current literature. Time to angiography and treatment were shorter in children with AA compared with AVM alone, although there was no difference in clinical outcome. Hemorrhage rates were similar, although emergent therapy was required more frequently in patients with AA. Our findings support the need for early diagnosis and treatment of associated aneurysms in children.

93. The Economic Impact of Ventriculo Peritoneal Shunt Failure

Chevis N. Shannon, PhD; Gavin T. Reed, BS (Birmingham, AL); Tamara D. Simon, MD (Seattle, WA); Meredith L. Kilgore, PhD; John C. Wellons, MD (Birmingham, AL)

Introduction: The costs to third party payers and the costs to individuals with hydrocephalus and their families have not been described. The purpose of this project was to determine the third party payer reimbursement rate and the primary caregiver out-of-pocket expenses associated with a shunt failure episode.

Methods: A retrospective study of children born between 2000 and 2005 who underwent initial ventriculoperitoneal (VP) shunt placement and who experienced a shunt failure requiring surgical intervention within 2 years of their initial shunt placement was conducted. Institutional reimbursement and demographic data from CHA were augmented with a caregiver survey of any out-of pocket-expenses encountered during the shunt failure episode. Institutional reimbursements and caregiver out-of-pocket expenses were then combined to give us the cost for a shunt failure episode at our institution.

Results: For shunt failures at our institution, the mean reimbursement total was $17552 (SD $34763), the mean caregiver out-of-pocket expenses was $902 (SD $1121), and the mean total cost was $18017 (SD $35147). Private insurance had a mean reimbursement rate of $21268 (SD $45191) compared to public insurance mean reimbursement rate of $14382 (SD $22252) (p=.0007). Caregivers with private insurance averaged $1279 (SD $1436) for out-of-pocket expenses while caregivers with public insurance averaged $536 (SD $434) for out-of-pocket expenses (p = .0066).

Conclusions: This study confirmed that private insurance reimbursed at a higher rate and that although patients had a shorter length of stay as compared to those with public insurance their out-of-pocket expenses associated with a shunt failure episode where greater.

POSTER ABSTRACTS

94. Combined Endovascular/Surgical Treatment of Giant AVMs in Children: Impact of Mult-Modality Treatment

Shervin R. Dashti, MD, PhD; Aaron Spalding, MD, PhD; Thomas Moriarty, MD, PhD; Tom Yao, MD (Louisville, KY)

Introduction: Giant AVMs are rare in the pediatric population. Treatment options include observation, surgery, radiosurgery, and/or endovascular therapy. Treatment success has been variable with substantial morbidity and mortality rates for each treatment option; in fact, some giant AVMs are still considered "inoperable". Recent advances in endovascular technology have increased the potential for successful treatment of highly complex cerebrovascular disease. We report here our initial results after treatment of pediatric giant AVMs using an aggressive combination of endovascular and open surgery.

Methods: The Norton Neuroscience Institute vascular/endovascular service includes 2 hybrid trained cerebrovascular surgeons utilizing 2 biplane angio/operating rooms. In this first year, 19 pediatric procedures have been performed (5 aneurysm and 4 avm) on children (ages 3 months – 17 years). Three high grade "inoperable" giant AVMs were treated with combined endovascular/vascular techniques.

Results: Median clinical and radiographic follow-up periods were 6 and 4 months respectively. Two patients had greater than 95% embolization of the nidus followed by surgical resection for complete treatment of the AVM. One patient, who was pregnant, had complete endovascular obliteration of her giant posterior fossa AVM. Short-term morbidity included one minor hemorrhage and one patient with transient SMA syndrome. All patients were neurologically intact at latest follow-up.

Conclusion: Advancements in endovascular techniques facilitate the treatment of previously inoperable giant AVM's in pediatric patients, either as monotherapy or by minimizing risk of open surgery.

95. Evolution of Treatment Options for Vein of Galen Malformations

Ketan R. Bulsara, MD; Dhruv Khullar, BA; Ahmed Andeejani, MD (New Haven, CT)

Introduction: Vein of Galen Aneurysmal Malformations (VGAMs) account for high morbidity and morality in the pediatric population. While in the past mortality rates were near 100%, recent developments in endovascular embolization have improved prognoses and some patients can achieve normal neurological development following embolization. Here we review the pathophysiology of VGAM and discuss treatment options.

Methods: A PubMed literature search was performed for Vein of Galen Malformation treatment options. 22 papers were reviewed in full and outcome data of 615 patients was compiled from 1983 to 2010. Articles were reviewed if they focused primarily on the treatment of VGAM and reported outcomes of at least 5 treated patients.

Results: Of the 265 patient outcomes reviewed from 1983 to 2000, 200 received endovascular therapy. 73% of these patients had a favorable outcome and a 15% mortality rate was found. Microsurgery was found to have an 84.6% mortality rate. Furthermore, 76.7% of patients of untreated patients died. 337 of the 350 patients assessed from 2000 to 2010 were treated endovascularly, mostly via the transarterial approach. Of these patients, 84.3% were found to have good or fair outcomes, and a 15.7% mortality rate was found.

Conclusions: In the past, the prognosis for patients with VGAM was dismal, and successful procedures were considered those that partially or completely obliterated the lesion, but did not necessarily improve the patient's symptoms. More recently, with the continued improvement of endovascular techniques, many patients are found to be neurologically normal on follow-up and mortality rates have dropped substantially.

96. Developmental Venous Anomaly Morphing Into an AV-Fistula Following Resection of an Occipital AVM

Howard J. Silberstein, MD, FACS; Babak Jahromi, MD, PhD; Gabrielle Yeaney, MD; Christian B. Kaufman, MD; Zeguang Ren, MD, PhD (Rochester, NY)

Introduction: We present a case of a six year old girl with an intracranial hemorrhage secondary to an AVM with an adjacent DVA . Following initial surgery for the hemorrhage and AVM resection,the DVA transformed developing multiple AV fistulas.

The purpose of this paper is to outline the surgical approach taken for treating this unusual vascular malformation and to present for the first time the angiographic and pathology findings for this unique entity.

Methods: Our case analysis includes pre and postoperative angiographic images as well as gross and microscopic pathology results

Results: Initial microcatheter angiography demonstred superficial plexiform AVM with a deeper uninvolved DVA. Following initial embolization and AVM resection, the patient suffered a recurrent hemorrhage one year later. Repeat angiography demonstrated recurrent AVM consisting of multiple fistulous connections between distal PCA vessels and the DVA. The patient under went occipital lobe wedge resection with pathologic confirmation.

Conclusions: This young girls clinical course, angiographic documentation of a DVA transforming into an AV fistula and the confirming pathology are a new addition to the literature and raise interesting questions regarding the pathogenesis of AVM's.

97. Successful Endovascular Treatment of a Holo-Hemispheric Cerebral Arteriovenous Fistula in an Infant

Heather Stevens Spader, MD; Jonathan A. Grossberg, MD; Thomas Murphy, MD; Lloyd Feit, MD; Mahesh V. Jayaraman, MD (Providence, RI)

Introduction: Cerebral arteriovenous fistula (CAVF) is an abnormality where direct subpial communication exists between a pial artery and a cerebral vein, without an intervening nidus. Historical series have placed the incidence of CAVF at 17% of pediatric AVMs. (1,2) We present a case of a giant neonatal holo-hemispheric CAVF treated with glue and coil embolization.

Methods: A four-day-old female presented with lethargy and poor feeding. On exam, she had congestive heart failure with a right to left shunt through a patent ductus arteriosus. A loud bruit was auscultated over her anterior fontanelle and MRI/A confirmed the presence of a left holo-hemispheric malformation.

Results: On day-of-life (DOL) 11, the patient continued to have cardiac failure, and was taken to angiography, where a CAVF supplied by the left anterior and middle cerebral arteries (ACA/MCA) and bilateral posterior cerebral arteries (PCA) was encountered. On DOL 11 and 18, n-BCA glue embolization was performed on ACA, MCA, and PCA feeders. When the patient's cardiac failure continued, she had transvenous coil embolization of the draining vein on DOL 54 and one final transarterial glue embolization on DOL 76. At 18 month follow-up, patient has mild motor and speech delays, but meets milestones. Her cardiac failure resolved.

Conclusion: This case demonstrates one of the largest CAVFs treated endovascularly in the neonatal population. (1) Tomlinson FH, et al. Arteriovenous fistulas of the brain and the spinal cord. J Neurosurg. 1993l;79:16-27. (2) Weon YC, et al. Supratentorial cerebral arteriovenous fistulas (AVFs) in children. Acta Neurochir. 2005;148:17-31.

98. Mechanical Thrombectomy for Pediatric Venous Sinus Thrombosis: Technical Note

Shervin R. Dashti, MD, PhD; Thomas Moriarty, MD, PhD; Tom Yao, MD (Louisville, KY)

Introduction: Cerebral venous sinus thrombosis (CVST) is rare in childhood, but can have devastating neurological sequlae. Systemic anticoagulation remains the primary treatment; however, there is little data supporting its use in children. The role of mechanical thrombectomy has not been evaluated in pediatric patients. AngioJet is a thrombectomy tool, primarily designed for peripheral vasculature. A microcatheter is passed through the venous system to the effected vessel(s) under angiographic guidance. A jet of heparinized saline is sprayed and aspirated (with dissolved clot) though two ports at the tip of the device. We have treated 12 cerebral venous sinus thrombectomy patients using AngioJet in a 2-year span. We report here the results of AngioJet thrombectomy on one pediatric patient.

Methods: A 17-year-old patient presented with 1-week history of severe headache, nausea, and blurred vision. Papilledema was present on fundoscopic exam. CT of the head was normal. MRI and MRV of the head showed complete thrombosis of the right transverse and sigmoid sinuses, right jugular bulb, right IJV, and partial thrombosis of the left transverse sinus. AngioJet mechanical thrombectomy was performed with complete recanalization of all affected venous structures.

Results: The patient was headache free immediately after the procedure and was kept on anticoagulation for 3 months to prevent rethrombosis. Follow-up MRV at 9 months showed continued patency of all venous sinuses and the IJVs. She remains headache free.

Conclusions: We believe this is the first report of a pediatric patient treated with AngioJet mechanical thrombectomy. It may be a safe, effective treatment option for children with CVST.

99. Large Vascular Malformation in a Child Presenting with Vascular Steal Phenomena Managed with Pial Synangiosis

Michael J. Ellis, MD; Derek Armstrong, MD; Peter Dirks, MD, PhD (Toronto, Canada)

Introduction: Management of large vascular malformations (VMs) presenting with non-hemorrhagic neurological deficits secondary to vascular steal phenomena is challenging and controversial. In many cases, large VMs cannot be completely cured leaving patients with partially treated VMs, the natural history of which is unknown. Management of children with Moyamoya disease involves consideration of surgical revascularization in order to enhance blood flow to the hemodynamically compromised hemisphere.

Methods: A two-year old female who presented with left sided weakness underwent neuro-imaging including cerebral angiography which demonstrated a 4.5cm VM with a complex arterial supply involving vessels of the anterior, posterior, and extracranial circulations. There was significant paucity of opacified vessels supplying the right frontoparietal regions consistent with vascular steal.

Results: The patient was initially treated conservatively, but two years later presented with left-sided hemiplegia secondary to a right middle cerebral artery infarct. After significant clinical recovery, and working on the assumption that right cerebral hemisphere was hemodynamically compromised as a consequence of vascular steal from the large VM, we elected to perform a right-sided pial synangiosis. At 9 months, the post-operative angiogram demonstrated robust neovascularization and the child has not sustained any further ischemic events.

Conclusions: Given the challenges of treating large, diffuse VMs presenting with vascular steal and neurological deficits, this report offers an alternative mode of treatment that may be used to augment flow to the hypoperfused cortex without causing abrupt disturbances in cerebral hemodynamics. Long-term follow-up is warranted to assess whether this technique can offer durable protection from further ischemic insults in this setting.

100. Five-Year Experience at a Fledging Pediatric Epilepsy Center

Luke Tomycz, MD; Mayshan Ghiassi, MD; Mahan Ghiassi, MD; Walter Jermakowicz, PhD; Vignesh K. Alamanda, BS; Gregory Barnes, MD; Matthew Pearson, MD (Nashville, TN)

Introduction: As experience with surgical treatment for medically-refractory, pediatric epilepsy grows, the neurosurgical community continues to refine its impression of outcomes that can be expected with various procedures.

Methods: Using billing and CPT codes, we reviewed the electronic charts of 132 consecutive patients who underwent epilepsy surgery at Vanderbilt Children's Hospital (VCH) from 2005 to 2010. Etiology of seizures, AED regimen, frequency and type of seizures, Engel class outcomes, and complications were recorded for each patient.

Results: Within this cohort, 47 patients underwent craniotomy for resection and the remaining 85 patients underwent vagal nerve stimulation for severe multi-focal epilepsy. Multiple subpial transection (MSPT) was performed in two patients in an attempt to address epileptogenic activity emanating from eloquent cortex. Engel I/II outcomes were achieved in 6/10 of the patients who underwent functional hemispherectomy, 1/6 of those who underwent corpus callosotomy, 4/6 of those who underwent selective amygdalohippo-campectomy, 6/6 of those who underwent standard temporal lobectomy, and 15/18 of those who underwent subdural grid placement for tailored resection of epileptogenic foci. Engel III/IV outcomes were obtained in the vast majority of those who underwent VNS implantation.

Conclusions: Outcomes from our center as assessed by Engel class compare favorably with previously published data. Successful surgery relies on careful patient selection and the cooperation of a multidisciplinary team of pediatric epileptologists, neuropsychologists, and neurosurgeons.

101. Can Limited Resections Treat Patients with Nonlesional Epilepsy

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

Introduction: The extent of cortical resection in patients with cortical dysplasia and nonlesional patients has been shown to correlate with the degree of seizure control. These resections are often large and reflect a extensive area of electrophysiological abnormality and the difficulty of precisely localizing the area of ictal onset. Often deep seated small dysplasias may result in widespread abnormality. Detection of these focal areas of epileptogenesis with the help of multimodality can limit resections.

Methods: We analyzed our recent experience with minimal resections in patients with nonlesional epilepsy. The seizure focus was detected using a variety of electrophysiological and multimodality imaging techniques to achieve good seizure control.

Results: Six patients with intractable nonlesional epilepsy were operated after an extensive preoperative workup to identify the epileptogenic region. The methods included ictal and interictal SPECT imaging, PET scan, invasive monitoring, specialized image coregistration techniques to precisely outline area of resection. Two of the six patients had to be reoperated in the immediate postoperative period to extend resections. One patient developed late recurrence of seizures after two years. All the remaining have been seizure free with a minimal follow up of 6 months.

Conclusion: While detailed electrophysiological analysis is the cornerstone of recognizing area of seizure onset, detailed image coregistration techniques can help further focus the precise area of abnormality, limit the area of cortical resection and associated sequelae.

POSTER ABSTRACTS

102. Abnormal Anisotropic Diffusion in White Matter and the Post-Op Recovery in Epilepsy Patients With TSC

Ian Mutchnick, MD; Francesco Mangano, DO; Ha-Yeon Lee; James Leach, MD; David Franz, MD; Ki Lee, MD; Scott Holland, PhD; Weihong Yuan, PhD (Cincinnati, OH)

Introduction: The goal of the study was to use diffusion tensor imaging (DTI) to quantify the abnormal fractional anisotropy (FA) and mean diffusivity (MD) in major whiter matter (WM) regions of patients with tuberous sclerosis complex (TSC).

Methods: Thirteen surgical patients with TSC (age range = 1 - 18 yrs) underwent pre-op DTI scans. Seven of these patients had post-op DTI scans and were analyzed longitudinally. Age matched controls were used for comparison.

Results: 4/13, 5/13, 5/13, 6/13 TSC patients had FA higher than upper limits of 99% prediction intervals for genu of callosum (gCC), splenium of corpus callosum (sCC), anterior limb of internal capsule (ALIC), and posterior limb of internal capsule (PLIC), respectively. Compared to the age matched controls, TSC patients had increased pre-op FA in sCC, ALIC, and PLIC ($p=0.007$, 0.001, and 0.012, respectively), decreased MD in sCC ($p=0.002$), and increased MD in both ALIC and PLIC ($p<0.05$). The longitudinal subset presented similar pre-op abnormality but the difference was significant only in FA in PLIC ($p=0.02$) and MD in sCC and PLIC ($p=0.03$, $p=0.03$, respectively). Post-op DTI parameters were not found to be significantly different from age matched controls for any of the ROIs examined.

Conclusion: The universal increase in FA and the region specific MD abnormality in TSC patients at pre-op evaluation are believed to be related to multiple factors including the proximity to lesions and the vulnerability of the WM to the disease. The longitudinal changes observed indicate a post-operative recovery in WM structural integrity.

103. In-Situ on Lay Epidural Fat Graft To Prevent CSF Leak in Pediatric Lumbar Spine Surgery

Gandhi Varma, MD (Columbus, OH); Narendra Nathoo, MD, PhD (Ohio State University Medical Center, OH); A.S. Hegde, MD, PhD (India, Sri Sathya Sai Institute of Higher Medical Science)

Introduction: The prominent pediatric lumbar epidural fat, different from subcutaneous fat, is characterized by homogeneity (regular adipocytes), scarcity of connective tissue and oriented slits making it a highly specialized semi-fluid functional layer in the mobile spine. CSF leak, a common avoidable complication following intradural spinal surgery, is associated with increased morbidity and neurologic sequelae. We report the use of an in-situ on lay epidural fat graft following intradural spine surgery to prevent a CSF leak.

Methods: Following laminectomy or laminotomy for dural exposure, the prominent epidural fat is incised in the midline or to one side and raised as a flap, stored to the side and covered with moist cottonoids. Upon completion of the planned intradural surgery, the dura is closed using 6'0 Proline in a continuous fashion to result in a water-tight closure. Then the epidural fat flap is reposition to cover the dural suture line. The wound was then closed in a multiple layers. Fibrin glue, sealants or artificial dural materials were not used.

Results: This technique was used in 16 patients with no CSF leak, wound infections or pseudomeningocele.

Conclusion: We report a simple, cost-effective technique using the prominent epidural fat as an in-situ on lay graft to prevent CSF leaks following intradural pediatric lumbar spine surgery. Unlike dural sealants, use of an in-situ on lay fat graft reduces the incidence of post-operative granulation tissue and scar formation.

104. Kyphectomy Using Pedicle Screw Only Constructs in Myelomeningocele Patients: A Report of 2 Patients

Steven W. Hwang, MD; William E. Whitehead, MD; Daniel J. Curry, MD; Todd Blumberg, BA; Thomas G. Luerssen, MD; Andrew Jea, MD (Houston, TX)

Introduction: Significant lumbar kyphosis is frequently observed in myelomeningocele patients and has been associated with functional impairment, decreased abdominal volume, respiratory impairment, discomfort, and skin ulcerations overlying the gibbus. Treatment of severe kyphotic deformities includes kyphectomies with ligation of the thecal sac to augment posterior fixation. However, most series have reported a high rate of morbidity and complications using these techniques. We describe a technique using pedicle screw only constructs without transection of the thecal sac to successfully treat severe kyphosis with minimal morbidity. We retrospectively reviewed medical records and radiographic images of 2 patients with myelomeningoceles who had kyphectomies performed at our institution. Both patients were male and had thoracic level myelomeningoceles repaired at birth with associated paraplegia. Neither patient had any significant scoliotic deformity associated with the kyphosis and both had T9 to iliac fixation using pedicle screw constructs with L1-2 kyphectomies. Patient 1 was 20 years old and treated for progressive kyphosis and an ulcerated wound over the gibbus. Patient 2 was 10 years old and treated for progressive pain and functional impairment. Our patients had a mean correction of 63% with a kyphotic deformity correction from 136° to 51°. Neither patient developed any complication post-operatively. Severe kyphotic deformities in myelomeningocele patients can be safely treated using pedicle screw only constructs without ligation of the thecal sac. Further evaluation with a larger sample and greater follow-up are needed to determine the associated complications with this technique and validate whether pedicle screw only constructs permit fewer instrumented levels.

105. C1-2 Instability from OS Odontoideum Mimicking Intramedullary Spinal Cord Tumor: Report of Two Cases

Paul Gigante, MD; Neil Feldstein, MD; Richard Anderson, MD (New York, NY)

Introduction: Os odontoideum is a common cause of atlantoaxial instability in the pediatric population. We present two cases with a clinical presentation and MR imaging consistent with an intramedullary neoplasm but whose ultimate diagnosis was cervical spine instability and cord injury from os odontoideum.

Methods/Results: Patient 1 presented with progressive spastic quadriparesis. MRI demonstrated focal intramedullary enhancement and T2 hyperintensity from the cervicomedullary junction to C3. An os odontodeum was also identified on flexion-extension radiographs with a 14mm ADI. She underwent posterior C1-C2 fusion, with clinical and radiographic improvement at 3 month follow-up. Patient 2 presented with progressive neck pain and myelopathy. MR demonstrated focal intramedullary enhancement at C1 with surrounding T2 hyperintensity. She underwent a cervical laminectomy for resection of a presumed neoplasm. Postoperative MRI demonstrated a gross total resection of the enhancing lesion, but final pathology was consistent with gliosis and inflammation, without evidence of tumor. She remained clinically stable after surgery, but presented one year later with progressive sensory loss. A previously unseen os odontoideum was identified with an ADI of 11mm. She underwent a subsequent posterior O-C2 instrumentation and fusion, with complete resolution of her myelopathy and radiographic resolution of the T2 hyperintensity at one year follow-up.

Conclusion: Children who present with progressive myelopathy should be carefully investigated for os odontoideum, because chronic trauma from C1-2 instability can produce focal intramedullary enhancement and cord edema that may mimick an intramedullary neoplasm. If instability is found, C1-2 stabilization should be considered before other intradural procedures are pursued.

106. Complete Anterior Atlantoaxial Dislocation in a Child: A Case Report

Brian M. Snelling, BS (Morgantown, WV); John H. Schmidt, MD (Charleston, WV)

Introduction: Traumatic anterior atlantoaxial dislocation is a rare injury in the pediatric population. No case reports documenting complete dislocation have been reported in the literature. We report here the case of a 10 year old male presenting with complete anterior atlantoaxial dislocation following a pedestrian accident with a motor vehicle. One and three-year follow-up of his recovery is documented.

Methods: The case was reviewed and discussed with the operating neurosurgeon. A thorough literature search was conducted for reports of similar injuries and for literature discussing the unique nature of pediatric cervical spine injuries, with specific regard to the biomechanical properties of the pediatric cervical spine.

Results: Patients under 11 years of age are more prone to injuries in the cephalic portion of the cervical spine, and dislocation is the most common form of injury. Our patient's admission CT scan showed the odontoid within 2 mm of the anterior edge of the posterior arch of C1. The patient underwent posterior surgical reduction of the dislocation and internal fixation of the occiput to C5 bilaterally. At one-year follow-up the patient remained quadriplegic. He was ventilator and PEG tube dependent. He had resumed his education with home schooling and was to attend public school the next year. At three year follow up, the patient remains quadriplegic and continues to be PEG tube and ventilator dependent.

Conclusions: The nature of this particular injury would lend itself to a high mortality rate and significant neurological sequelae. However, with dislocation reduction and occipitocervical fusion, mobilization and long-term outcomes can be achieved.

107. Association Between Pediatric Arachnoid Cyst Size and Head Trauma and Cyst Rupture/Hemorrhage

Marshall Cress, MD (Columbia, MO); John Kestle, MD,FRCS(C); Jay K. Riva-Cambrin, MD,FRCS(C) (Salt Lake City, UT)

Introduction: As the availability of imaging modalities has increased, the finding of arachnoid cysts has become common. Accurate patient counseling, regarding physical activity or any risk factors for cyst rupture or hemorrhage, has been hampered by the lack of definitive association studies.

Methods: A radiological and two clinical databases were investigated to identify 307 new diagnoses of arachnoid cysts at a single institution from 2005-2010. Fourteen cases were found with the outcome of the arachnoid cyst having ruptured with resultant subdural hygromas or having bled with resultant subdural hematomas. Two unruptured/ non hemorrhagic controls were matched to each case based on patient age, gender, anatomical cyst location, and side. Risk factors evaluated included arachnoid cyst size, recent history of head trauma, and altitude at which the patient resided.

Results: The proportion of imaged arachnoid cyst rupture/hemorrhage from the databases was 4.6%. Larger cyst size, as defined by maximal cyst diameter, was significantly associated with cyst rupture/hemorrhage ($p = 0.002$). When dichotomized with a 5 cm cut-off, 9/13 children with a larger cyst ruptured and/or hemorrhaged versus 5/29 children with smaller cysts; for an odd's ratio of 10.8 (CI [2.4, 49.5]). A recent history of head trauma was also significantly associated with the outcome ($p < 0.001$) and had an odd's ratio of 36 (CI [5.8, 225.2]); whereas altitude was not.

Conclusions: This case-controlled study establishes that larger arachnoid cyst size and recent head trauma are risk factors for symptomatic arachnoid cyst rupture/hemorrhage.

108. Temporal Classification of Non-Accidental Head Trauma Admission Associates with Discharge Outcomes in Children

Sudhakar Vadivelu, DO; Debra Esernio-Jen, MD; Raj K. Narayan, MD; Mark A. Mittler, MD; Steven J. Schneider, MD (Manhasset, NY)

Introduction: The aim of this study was to review our ten year experience with NAHT and identify whether classification temporal admission delay is associated with discharge outcomes.

Methods: Admission criteria were prospectively for the child protective services registry. This study retrospectively reviewed patients diagnosed with NAHT between the years of 1998 - 2009 and examined those patients in which the perpetrator was specifically identified. Admission delay was classified into three categories: acute (0-6 hours), subacute (6-12 hours), and complete delay (x>12 hours). Outcomes upon discharge were assessed using the King's Outcome Scale for Childhood Head Injury (KOSCHI).

Results: Age ranged from 2.1 to 34 months. Nineteen (68%) patients were male, while most perpetrators were female. Initial examination revealed a delay (subacute and complete delay) in child arrival to the hospital in a majority (17/28; 61%) of patients. A low arrival GCS ($p<0.0001$) and associated extracranial injuries ($p<0.0061$) correlated with lower outcomes. Patients with a low arrival GCS score ($x<7$) arrived predominantly in an acute or subacute time. However, those patients in the acute and complete delay classification were more likely to have a higher KOSCHI outcome score upon discharge ($p<0.0426$). Six patients had decompressive craniectomies of which two were classified as arriving in an acute time and the other four classified as subacute. Both of these acute classified patients were discharged to rehab facilities, while the four subacute patients consequently resulted in hospital mortality.

Conclusion: Temporal classification of admit delay in NAHT is associated with discharge outcomes.

109. Profile of Children Returning to School After TBI: A Qualitative Study

Shobhan H. Vachhrajani, MD; Maureen Dennis, PhD; Dorcas Beaton, PhD; Peter Rumney, MD; Abhaya V. Kulkarni, MD, PhD (Toronto, Canada)

Introduction: Traumatic brain injury (TBI) remains a leading cause of morbidity and mortality for children worldwide. Return to school is paramount, however no validated instrument exists that measures global function in school after TBI. This study aims to develop the profile of the child who returns to school after TBI in order to identify items for a novel measure.

Methods: Focus groups were conducted with rehabilitation professionals and teachers in hospital, neurorehabilitation, and community school settings in Toronto, Canada. A semi-structured question guide was used to explore concepts deemed important from a literature search. All focus groups were transcribed verbatim, and grounded theory techniques of coding and analysis were employed to extract key concepts and form higher level themes.

Results: Sequelae of pediatric TBI vary in spectrum and severity with no typical presentation. Children grow into their injury, falling progressively behind their uninjured peers. In the school setting, difficulties in working memory, problem solving, language, planning, inattention, impulsivity and hyperactivity are readily observed. A variety of physical deficits are also observed. Social relations are impaired, with children becoming isolated and vulnerable to exploitation. Dynamically impaired executive function and social competence best describe the collective profile of this population.

Conclusions: Children returning to school after TBI suffer functional deficits in many domains. These are readily manifest in the school environment, but are often unrecognized by teachers. Developing a disease and context specific measure of school function after TBI will promote identification and comprehensive rehabilitation of this vulnerable population.

POSTER ABSTRACTS

110. Does A Single Anesthetic Exposure Increase Neuronal Apoptosis in the Early Postnatal Piglet?

Beth A. Costine, PhD; Sabrina R. Taylor, BS (Charlestown, MA); Ann-Christine Duhaime, MD (Boston, MA); Simon C. Hillier, MD (Lebanon, NH)

Introduction: In early postnatal rodents, administration of anesthetic drugs commonly used in children is associated with widespread neuronal apoptosis and persistent learning and memory impairments. Although the human clinical correlates of these data are uncertain, there are obvious implications for the 4 million infants and children that undergo anesthesia in the US each year. A recent retrospective analysis suggests an increased incidence of learning disabilities in children having repeated anesthetic exposures.

Methods: Here we utilize piglets, which have a brain morphology and pattern of development similar to human infants, to test if a single, six hour exposure to 2.3 % isoflurane increases neuronal apoptosis in the hippocampus, thalamic nuclei, and the rostral gyrus of the cortex. During the anesthetic exposure, mean arterial pressure, end tidal CO_2, heart rate, oxygen saturation, glucose concentration, body temperature, and arterial blood gases were successfully maintained within a narrow range.

Results: Preliminary data indicate that the number of apoptotic non-neuronal cells may be increased in the various nuclei of the thalamus compared to naïve piglets, but the number of apoptotic neurons was not different among anesthetic exposed and naïve piglets in the thalamus, rostral gyrus of the cortex or hippocampus.

Conclusions: Preliminary results indicate that a single exposure to isoflurane had a minimal effect on the number of apoptotic neurons. If repeated exposure to anesthetics is required to induce neuronal apoptosis in children, the piglet may serve as a valuable model to test interventions that may reduce the potential toxic effect of anesthetics.

111. Rotatory Subluxation: Experience from the Hospital for Sick Children

Alexandra D. Beier, DO (Southfield, MI); Shobhan Vachhrajani, MD (Toronto, Canada); Simon Bayerl (Berlin, Germany); Claudia Y. Diaz Aguilar (Nuevo Leon, Mexico); Maria Lambert-Pasculi, RN; James M. Drake, MB (Toronto, Canada)

Introduction: Diagnosis and management of atlantoaxial rotatory subluxation (AARS) is challenging due to variability in clinical presentation. Although several treatment modalities have been employed, there remains no consensus on the most appropriate treatment. We explore this issue in our nine-year series of AARS.

Methods: Records of patients diagnosed radiographically and clinically with AARS between May 2001 and March 2010 were retrospectively reviewed. Of 40 patients identified, 24 patients were male and were on average 8.5 years old (range 15 month to 16 years). AARS etiology included trauma, congenital abnormalities, juvenile rheumatoid arthritis, post-infectious, post-surgical, and cryptogenic. Four patients had dual etiology. Symptom duration was variable: 29 patients had symptoms for less than four weeks, five patients had symptoms between four weeks and three months, and six patients had symptoms for three months or more.

Results: Cervical collar was sufficient in 21 patients. One patient failed collar management and reduced with halter traction. Seven patients underwent initial halter traction, however four patients progressed and required halo traction. Two patients were placed in a halo upon presentation due to severity of rotatory subluxation; both required subsequent operative fusion. One patient required upfront decompression and fusion due to severe canal compromise and myelopathy.

Conclusions: Management of AARS is variable due to the spectrum of clinical presentation. Those presenting acutely without neurological deficit can likely be managed in a collar; those who are irreducible or present with neurological deficit may require traction and/or surgical fixation.

112. Mean Arterial Pressure in Extended Synostectomies: What Really Matters?

Mitchel Seruya, MD; Robert F. Keating, MD; Michael J. Boyajian, MD; John S. Myseros, MD; Amanda L. Yaun, MD; Albert K. Oh, MD (Washington, DC)

Introduction: This study of extended synostectomies analyzed the relationship between intraoperative mean arterial pressure (MAP) on estimated blood loss (EBL), calculated blood loss (CBL), transfusion requirements, and length of stay (LOS).

Methods: The authors reviewed all infants with sagittal synostosis who underwent extended synostectomies at a single institution from 1997 - 2009. Patient demographics, and intraoperative MAP, including average, minimum difference, maximum difference, and variance were assessed. Outcomes included EBL (percent estimated blood volume), CBL (% EBV), intraoperative transfusion of red blood cells (RBC), total hospital transfusion of RBC, and LOS.

Results: 71 infants were identified. Mean surgical age and weight were 4.9 months and 7.3 kg, respectively. Average intraoperative MAP was maintained at 54.6 mmHg. Mean EBL was 12.7 % EBV and CBL was 23.6 % EBV. There was no statistical association of EBL with MAP parameters. CBL positively correlated with MAP variance ($r = 0.278$, $p = 0.044$). Intraoperative transfusion of RBC was given to 60% of patients, without statistical relationship to MAP parameters. Total hospital transfusion of RBC was given to 80% of patients, the amount positively correlating with mean MAP ($r = 0.261$, $p = 0.028$). Mean LOS was 2.3 days, without statistical association with MAP parameters.

Conclusions: In our analysis of controlled systemic hypotension in patients undergoing extended synostectomies for sagittal synostosis, higher CBL trended with increased MAP variability. Total hospital blood transfusion requirements positively correlated with mean MAP. These findings highlight the benefit of steady, controlled systemic hypotension on blood loss and blood resuscitation.

113. Craniosynostosis Incision: Scalpel or Cautery?

Victor L. Perry, MD; Ben Kittinger; Elda Fisher; John van Aalst, MD (Chapel Hill, NC)

Introduction: Debate remains as to the optimal bicoronal incision method for pediatric craniosynostosis surgery: scalp versus electrocautery. There remains a need to address this issue in efforts to decrease wound complications and maximize cosmesis. The results of our study may help guide the surgical approach to bicoronal incisions in the future.

Methods: A retrospective chart review of surgical correction of craniosynostosis at UNC between 7/1/2007 to 1/1/2010 was performed. Each patient served as their own control as each incision was made half with needle tip cautery and half with knife. Data was collected from all patients who had a bicoronal incision for craniosynostosis.

Results: We reviewed a total of 65 cases of craniosynostosis that underwent surgical correction. Of the 65 cases, 23 total complications (35%) were found including 11 minor complications (17%), 7 moderate complications (11%), and 6 severe complications (9%). Of the 8 minor complications, 5 were from the Knife group, 3 were from the Cautery group, and 3 were in the Other Complications group. The 7 moderate complications included 2 cases in the Knife group, 1 in the Cautery group and 4 in the Other Complications group. The 6 severe complications involved 1 case in the Knife Group, 1 case in the Cautery group, and 4 cases in the Other Complications group.

Conclusions: Based upon the results of this study, for patients undergoing surgical correction of craniosynostosis there appears to be no significant difference between the use of knife or needle tip cautery in regards to minor, moderate or severe wound complications.

114. Distraction Osteogenesis for Expansion Cranioplasty in Symptomatic Craniostenosis

Julia A. Radic, MD (Halifax, Canada); D. Douglas Cochrane, MD (Vancouver, Canada); P. Daniel McNeely, MD (Halifax, Canada)

Introduction: Distraction osteogenesis is used commonly in the axial skeleton, midface and mandible to overcome growth deficiencies. The lengthening exceeds that which could be achieved in a single or series of operations. In symptomatic craniostenosis, cranial vault expansion is traditionally performed as a single or staged operation. We present two children diagnosed with symptomatic craniostenosis, who were treated successfully with distraction osteogenesis.

Methods: The first child was originally subjected to multiple operations in an attempt to achieve a satisfactory intracranial volume. Unfortunately, each procedure achieved limited volume expansion and was followed by rapid re-ossification and cessation of growth in head circumference. Initial volume expansion using resorbable poly-L-lactic-polyglycolic distractors was unsuccessful because of device failure. A second attempt using custom devices was successful in achieving the goal head circumference. Following this experience, a second infant was treated successfully using standard titanium distractor components. There were no infectious complications.

Results: In these patients, distraction osteogenesis resulted in intracranial expansion exceeding that which could be achieved using standard techniques.

Conclusions: Distraction osteogenesis is an effective management option for cranial vault expansion in children with symptomatic craniostenosis.

115. Age of Surgery as a Risk Factor for Re-Operation in Syndromic Craniosynostosis Patients

Robin Yang, DDS; Violette Recinos, MD; Kaisorn Chaichana, MD; Edward Ahn, MD; Benjamin Carson, MD; Oliver Simmons, MD (Baltimore, MD)

Introduction: Craniofacial synostosis syndromes are rare disorders often characterized by premature fusion of multiple cranial sutures. Timing of surgery in these patients must take into account the rapid brain expansion during infancy and the continued growth of the craniofacial skeleton. The goal of primary intervention is a balance between preventing permanent neurological sequela and minimizing post-operative skeletal regrowth and fusion requiring further operative intervention. Because of the proclivity toward boney regrowth and fusion in younger children, we hypothesize that earlier operative interventions of syndromic craniofacial patients lead to increased rates of major cranial re-operations.

Methods: Retrospective chart reviews of all syndromic craniosynostosis patients at Johns Hopkins Hospital during a 19-year period from 1991 to 2009.

Results: Forty-nine patients were treated for syndromic craniosynostosis. The average number of sutures involved per patient was 2.6 (range 1-6). There were a total of 104 major cranial procedures performed with an average of 2.2 major surgeries per patient (range 1-5). Twenty-nine patients (59.1%) required reoperation. Average age of initial surgery was 19 months (range 0.5-96 months). Average time for re-operative interventions was 15 months. Increasing age was associated with a decreased risk of re-operation. [relative risk (95% confidence interval); 0.979 (0.052-0.997, p =0.02)]. An increasing number of sutures was associated with an increased likelihood of re-operation. [relative risk (95% confidence interval); 1.451 (1.038-2.015, p=0.03)].

Conclusion: Syndromic craniosynostosis is a disorder that may require multiple surgical interventions especially if multiple sutures are involved. Early surgical intervention is associated with a higher re-operative relapse rate requiring additional cranial procedures.

116. Comparison of Posterior Fossa Decompression with Duraplasty Versus Osseous Decompression in Type I Chiari Malformation

Amy Lee, MD; Chester Yarbrough, MD; Spiros Blackburn, MD; David Limbrick, MD, PhD; Matthew Smyth, MD (Saint Louis, MO)

Introduction: This study compares posterior fossa decompression with duraplasty (PFDD) with the osseous-only approach (PFDO).

Methods: We conducted a retrospective review of 61patients who underwent surgery for symptomatic CM1 from 2003 to 2010 at our institution. Age, preoperative symptoms, presence of syringomyelia, surgery type (duraplasty or osseous), surgical duration, hospital days, clinical outcome, and complications were reviewed.

Results: All 61 patients underwent suboccipital craniectomy with at least C1 laminectomy. The most frequent symptoms were headaches (77.2%), neck pain (21.0%), bulbar dysfunction (17.5%), nausea/vomiting (14%), and sensory changes (12.3%). In the PFDD group (36), average surgical time was 2.8 hours and median hospital days was 3 (range 1-41). Twenty-seven patients (75.0%) had complete resolution of symptoms, while all (100%) showed improvement at follow-up (mean 23.6 months, range 1-53). Five patients (13.9%) required re-operation for pseudomeningocele repair (3 with concomitant CSF leak). Of 13 patients with syringomyelia, 10 (73.5%) showed improvement. In the PFDO group (25), average surgical time was 1.6 hours and median hospital days was 2 (range 1-3). Fourteen patients (56.0%) had complete resolution of symptoms while 22 (88.0%) showed improvement at follow-up (mean 8.1 months, range 1-24). Only one patient (4.0%) that underwent PFDO required re-operation for duraplasty. Of 3 patients with syringomyelia, all showed improvement after PFDO.

Conclusions: Osseous-only decompression showed comparable improvement in symptoms with shorter surgery time and length of stay, with substantially fewer complications requiring re-operation. This represents an effective treatment option; leaving PFDD as a subsequent option should PFDO fail to relieve symptoms.

117. Cyst-Lateral Ventricle Stenting as Primary or Salvage Treatment for Posterior Fossa Arachnoid Cysts

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Introduction: The optimal treatment of symptomatic posterior fossa arachnoid cysts is controversial. Options include shunting or resection/fenestration. Patients treated with either option may have clinical recurrence. Shunted patients incur the risk of infection, failure, and shunt-related headaches. Headaches may be especially problematic with posterior fossa cysts, as shunting may create a pressure differential between the cavity and other intracranial spaces. Cyst-ventricular stenting has been described as an option for supratentorial cysts. This paper describes our experience with stenting posterior fossa cysts.

Methods: A retrospective review of 79 consecutive patients from 1993-2010 with surgically treated arachnoid cysts was performed.

Results: Thirty patients (38.0%) had posterior fossa cysts. The initial surgical therapy consisted of cyst-peritoneal shunting in 7 (23.3%) and fenestration/resection in 22 (73.3%). One patient was treated initially with a stereotactically placed cyst to ventricle stent. Two other patients had stents placed after a failure of open surgical treatment. All 3 stented patients clinically improved. Two patients have remained asymptomatic with radiographic stability at 1 and 5 year follow-up. The third patient had initial improvement and a demonstrable reduction of intracystic pressure, however he developed recurrent headaches after two years.

Conclusions: Posterior fossa cyst-ventricle stenting offers the benefits of surgical ease, low morbidity, and may reduce shunt related headaches by equalizing the pressure between the posterior fossa and the supratentorial compartment. While fenestration remains first-line therapy for most symptomatic arachnoid cysts, we consider cyst-ventricle stenting to be a valuable additional strategy in treating these often difficult lesions.

POSTER ABSTRACTS

118. Access to Health Care in Young Adults with Spina Bifida with a Medical Home

Philipp R. Aldana, MD; Richard Postlethwait, PA-C; Ian Heger, MD, FACS; David Wood, MD; Hector James, MD (Jacksonville, FL)

Introduction: Transition of the young adult with spina bifida (YASB) from pediatric to adult health care is considered a priority by organized pediatrics. There is a paucity of transition programs and related studies. JaxHATS clinic is one such transition program in Jacksonville, Florida. This study's purpose was to evaluate the health care access in YASB who have transitioned to an adult medical home.

Methods: A survey tool addressing access to health care, quality of health and life was developed, based on established surveys. Records of the Wolfson Children's Hospital Spinal Defects and JaxHATS clinics were reviewed and YASB(>18 & <30 years) were identified.

Results: 10 of the 14 YASBs invited in the Jacksonville area completed their surveys. Mean age was 23.25 years. All reported regular medical home visits, 8 with JaxHATS, 2 with other family care groups. All reported easy access to medical care and routinely visits to spina bifida specialists; none reported difficulty delays in obtaining health care. 2 patients were hospitalized in the last year for any medical problem. 9 report good to excellent quality of life (QOL). Family, lifestyle, and environmental factors were also examined.

Conclusions: In this small group of YASB with a medical home, easy access to care for medical conditions was the norm, with few having recent hospital or ER visits and almost all reporting at least a good overall QOL. Larger studies of YASBs are needed to evaluate the positive effects of medical homes on health and quality of life in this population.

119. Stridor at Birth Predicts Poor Outcome in Neonates with Myelomeningocele

Eylem Ocal, MD; Shibu Pillai, MD; Bew Irwin, RN, BS; Ash Singhal, MD, FRCS(C); Douglas D. Cochrane, MD, FRCSC; Paul Steinbok, MD, FRCS (Vancouver, Canada)

Introduction: Stridor, associated with vocal cord paralysis, in neonates with myeleomeningocele (MMC) is a recognized symptom related to the associated Chiari II malformation. In most children, stridor first appears days to months after birth and urgent decompression of the Chiari malformation and control of hydrocephalus, if present, are usually recommended. With such management, variable improvement in symptoms typically occurs. In some newborns with MMC, stridor is present at birth and may be secondary, in part, to maldevelopment rather than compression of the medulla. There is minimal literature describing the outcome after Chiari decompression in this population. The purpose of this study was to review the outcomes of neonates with MMC and stridor at birth treated with control of hydrocephalus and Chiari decompression.

Methods: Retrospective review of newborns with MMC and stridor at birth.

Results: 5 patients with MMC who presented with stridor at birth were identified. All had closure of their MMC with treatment of their Chiari malformation and hydrocephalus within first two weeks of life. None improved after surgery. All died; two within 1 month, the others 12, 36 and 45 months.

Conclusions: Stridor at birth may predict dismal outcome. Unlike the situation in neonates who develop stridor after birth, the outcome does not seem to be impacted by Chiari decompression. Non operative management may be a reasonable option to offer in this population.

120. Putative Relationship Between Chiari I Malformation and Obesity in Teenagers

Matthew Tormenti, MD; Christopher Bonfield, MD; Sandi K. Lam, MD; Yue-Fang Chang, PhD; Stephanie Greene, MD (Pittsburgh, PA)

Introduction: The teenage obesity epidemic in the United States is well recognized. Concomitant with this increase in obesity is an increase in the prevalence of the diagnosis of Chiari I malformation (CMI). This study was designed to determine the presence of a correlation between obesity and CMI.

Methods: We retrospectively reviewed the charts of all children 13 years and older presenting with CMI confirmed by >5mm of tonsillar ectopia on sagittal MRI. IRB approval was granted. Demographics, chiari size, and BMI were recorded. Statistical analysis was performed. Normal weight is defined as a BMI between the 5th and 85th percentile. Overweight is defined as 85th to 95th percentile and obese defined as greater than 95th percentile. Statistically 29.6% of children in Pennsylvania are overweight or obese.

Results: A total of 84 patients were included with a mean age of 14.9 1.6 years (range 13-20). Mean BMI was 24.5 5.4. Adjusted for age, 45% of patients were normal weight, 34% were overweight and 20% were obese. Ten patients presented with syringomyelia. Six (60%) of these patients were either overweight or obese. Thirty- seven patients presented with occipital headache. Twenty (54%) of these patients were either overweight or obese.

Conclusions: This study shows that teenagers with CMI are more likely to be overweight or obese than the normal population. More than half of the patients in this cohort who presented with syringomyelia or headaches were also obese. Prospective studies evaluating these associations are necessary to further support this association and may possibly lead to weight loss strategies for prevention.

121. Extra-Axial Fluid Collection of Infancy as a Risk Factor for the Development of Arachnoid Cysts

Julian J. Lin, MD; Brandon J. Bond, BA; Arnima Bhasin; Lynn Lyle, RN (Peoria, IL)

Introduction: Benign extra-axial fluid collection of infancy is associated with macrocephaly. This entity could be related to immature arachnoid granulation leading to temporary CSF accumulation along the convexity of the brain. This preliminary study was undertaken to investigate a possible relationship between benign extra-axial fluid collection of infancy and middle fossa arachnoid cysts.

Methods: The CT scans of all infants aged 12 months and younger that were diagnosed with benign extra-axial fluid collection of infancy at our institution recently were reviewed for evidence of arachnoid cyst especially at the floor of the middle fossa.

Results: Out of 20 infants diagnosed with benign extra-axial fluid collection of infancy, 15 (75%) were identified on CT imaging as harboring middle fossa arachnoid cysts. These infants were 4 to 10 months of age (mean=8.2, median=8.0), and there was a marked male preponderance (82%). Follow up CT scans demonstrated spontaneous cyst resolution in 9 infants. One child developed a large middle fossa arachnoid cyst requiring shunting of the cyst. One child developed extra axial fluid collection following subdural bleeding due to inflicted injury that eventually evolved into a small and persistent left middle fossa arachnoid cyst. One child who needed subdural shunt for symptomatic extra axial fluid collection showed a small and persistent middle fossa arachnoid cyst following shunt removal.

Conclusions: Based on our preliminary findings, the presence of extra-axial fluid collection of infancy may be associated with an increased risk for the subsequent development of middle fossa arachnoid cysts. Potential mechanism and pathophysiology will be discussed.

123. Intramedullary Abscess Secondary to Non Dermal Sinus Related Dermoid Cyst in the Cervicothoracic Region

Gandhi Varma, MD (Columbus, OH); Satish Rudrappa, MD (India, Sri Sathya Sai Institute of Higher Medical Science); Narendra Nathoo, MD, PhD (Columbus, OH); A.S Hegde, MD, PhD (Bangalore, India)

Introduction: Intradural dermoid cysts, most commonly presenting in the lumbar region are rare, accounting for 1% of intra spinal lesions. We report a unique case of a toddler with an intramedullary dermoid without a dermal sinus in cervicothoracic area.

Methods: A febrile toddler presented with regression of milestones, nucal rigidity, features of lower brainstem and spinal cord involvement. Neurological examination revealed bulbar palsies, quadriparesis and a Horner's syndrome with midline skin dimple at T4 level with no sinus. Contrast enhanced MRI of the cervico-thoracic spine revealed a long level rim enhancing intramedullary lesion from T5 to the lower medulla.

Results: The cervicomedullary abscess was drained first via a limited suboccipital craniectomy and C1-2 laminectomy. Via C6 to T5 laminectomy and midline myelotomy, the infected dermoid contents were removed; however subtotal resection could only be performed due to an adherent capsule wall. Staphylococcus aureus was isolated and intravenous antibiotic therapy was commenced according to sensitivity. Post-operative hydrocephalus was treated with ventriculoperitoneal shunt insertion. At 1year follow-up the patient had no bulbar palsies and was able to ambulate independently. Recurrence of dermoid cyst required repeat excision at 2 years with good outcome.

Conclusion: Intramedullary abscess secondary to an infected dermoid cyst with no dermal sinus in the cervicothoracic region is a truly unique presentation.

124. Cervical Congenital Dermal Sinus Complicated with Intramedullary Abscess in a Child: Case Report and Review of Literature

Antonio De Tommasi, MD; Antonio Calace, MD; Nunzio Bruno, MD; Nicola Zelletta, MD; Floriana Sardelli, MD; Giuseppe Occhiogrosso, MD (Bari, Italy)

Introduction: Dermal sinus tract (DTS) is an uncommon spinal dysraphism presenting in childhood. DST has been reported along the midline neuroaxis, from the occiput down to the lumbar and sacral regions, more frequently occurring in the lumbo-sacral tract. Cervical localization of the DST is rare. Exceptional its association with intramedullary abscess through cutaneous fistula.

Methods: A 9 month old baby was admitted to our Unit suffering from right hemiparesis. Physical examination showed a cervical midline cutaneous fistula dripping a yellowish thick liquid. Cervical MRI showed at C5 level a sinus tract in continuity with a C3 - C6 intramedullary lesion. The patient underwent surgery with isolation of the fistula followed by C3 - C6 laminectomy. Opened the dura around the deep fistula, the arachnoid appeared thickened and adhered to an intramedullary neoformation communicating with the dermal sinus. Total removal of the fistula and the intramedullary lesion was performed. Histopathological examination confirmed the diagnosis of dermal sinus and abscess.

Result: Post-operative cervical MRI showed a complete removal of the spinal dysraphism, fistula and intramedullary abscess. The baby showed a progressive improvement of right hemiparesis. The post operative course was without complications and the baby was discharged on day 10 post-surgery and addressed to a neuro-rehabilitation Center.

Conclusion: Cervical dermal sinus associated with intramedullary abscess is extremely rare. The literature review confirms that an early diagnosis, mostly a prompt surgical intervention, give chance of a good functional neurological recovery.

125. Apparent Life Threatening Events in Infants with Achondroplasia

Catherine A. Mazzola, MD; Jessica Korasadowicz, BS; Pamela Deangelis, RN; Helen Uczkowski; Thomas Sernas, PA-C (Morristown, NJ)

Introduction: Achondroplasia is the most commonly encountered skeletal dysplasia. Most infants with achondroplasia are neurologically normal at birth. Infants presenting with an apparent life threatening event (ALTE) should be carefully evaluated for cervicomedullary stenosis. Compression at the cervicomedullary junction (CMJ) can cause lower cranial neuropathies, central sleep apnea, opisthotonic posturing, myelopathy, and other neurological sequelae. Obstructive apnea from shortened skull base and oropharynx may also contribute to ALTE. Many infants with achondroplasia who have CMJ compresion also have some degree of ventriculomegaly. Most of these infants are not symptomatic from hydrocephalus, but do demonstrate neurological symptoms from brainstem and upper cervical spinal cord compression. We compare and contrast cases of infants with achondroplasia, and discuss the salient features of neurological examination relative to achondroplasia. The timing of neuroimaging studies and various modalities of imaging the CMJ in infants are reviewed. Somatosensory evoked potentials (SSEP) and sleep studies give important clinical information for the evaluation of infants with achondroplasia. Although SSEP's are not always reliable in infants, we have found SSEP useful during surgical decompression, and for baseline comparison studies. Early CMJ decompression in symptomatic infants with achondroplasia may prevent ALTE and sudden death in these babies. It is therefore important to understand the signs and symptoms of CMJ in infants with achondroplasia and other cervical spine anomalies.

126. The Prevalence and Imaging Characteristics of Syrinx in Patients with Chiari Malformation

Jennnifer Strahle, MD; Joseph Kapurch, BS; Mohannad Ibrahim, MD; Karin M. Muraszko, MD; Hugh J. L. Garton, MD, MHSc; Cormac O. Maher, MD (Ann Arbor, MI)

Introduction: The prevalence and associated MRI characteristics of syrinx in CM is not well defined as surgical series are biased towards inclusion of patients with syrinx.

Methods: A review of the electronic records of 14,116 consecutive children undergoing brain or cervical spine MR imaging at a single institution was performed. In patients identified with CM on MRI, demographic, clinical, and MRI information was recorded.

Results: There was a 3.6% MRI prevalence (509/14,227) of CM in our study population. The mean tonsillar descent below the foramen magnum was 10.1mm and did not vary by age. Syrinxes were rarely found in infants and were seen with greater frequency with advancing age during the first 5 years of life. After 5 years of age, syrinx prevalence did not vary by age. 23% of those with CM also had a spinal syrinx and 86% of the syrinxes involved the cervical spine. Syrinx was more prevalent in girls than boys ($p<0.0001$). Syrinx was associated with greater tonsillar descent ($p<0.0001$) and abnormal CSF flow ($p<0.0001$). CSF flow impairment was associated with amount of tonsillar descent ($p<0.0001$) and tonsillar conformation ($p<0.0001$). Patients were more likely to be considered symptomatic if they were female ($p<0.0001$), older ($p=0.0002$), had a syrinx ($p<0.0001$), abnormal tonsillar pulsations ($p<0.0001$), or greater tonsillar herniation ($p<0.0001$).

Conclusions: CM is a frequent finding on MRI. An increasing degree of tonisllar descent is associated with an increased risk of syrinx. Syrinx prevalence in CM patients increases during the first 5 years of life.

POSTER ABSTRACTS

127. Leber's Congenital Amaurosis Associated with Chiari I Malformation: Two Cases and Review of the Literature

Anthony L. Petraglia, MD; Eric B. Hintz, MD; Mina M. Chung, MD; Howard J. Silberstein, MD (Rochester, NY)

Introduction: Leber's congenital amaurosis (LCA) is a rare, clinically and genetically heterogeneous, inherited disorder that affects approximately 3,000 people in the United States. The disorder is characterized by severe loss of vision early in the first year of life; however, some patients also manifest developmental abnormalities of the central nervous system (CNS). While neuroradiological studies have revealed a variety of cerebral anomalies in association with LCA; Chiari I malformations (CMI) have never been described.

Methods: We report two sisters that were referred to the pediatric neurosurgery clinic for evaluation of CMI.

Results: The eldest sister presented with convergence nystagmus from 3 months of age and MRI demonstrated evidence of significant CMI. The nystagmus worsened and the patient developed gagging symptoms. She underwent suboccipital decompression and her symptoms improved but then returned, although not as severe as pre-op. Post-operative imaging revealed an adequate decompression. She was subsequently diagnosed with LCA. Similarly, her younger sister began developing nystagmus at 4 months old. She was also tested for and found to have LCA. Additionally, her MRI demonstrated CMI; however, we have opted to treat her conservatively at this time. Case specifics, imaging, and a review of the literature will be presented.

Conclusions: Chiari I malformations have been found in association with several genetic syndromes, but not with LCA. These patients represent the first reported cases of CMI in LCA and suggest an additional potential CNS anomaly. The familial aggregation and its unique occurrence in siblings with an inherited disorder is suggestive of a genetic basis to CMI.

128. Stop the Clot! Deep Vein Thrombosis and Femoral Vein Central Venous Lines in the Pediatric Population

Christina Notarianni (Shreveport, LA); Brent Kimball, MD; Joe Brigance, RN; Emily Snider, FNP; Tracy Tidwell, FNP; Frederick Boop, MD, FACS (Memphis, TN)

Introduction: Deep vein thrombosis (DVT) in children is an uncommon event. This study examines the rate of DVT after femoral vein central venous line (CVL) in a pediatric intensive care unit (PICU).

Methods: A retrospective review was conducted on PICU patients from June 2009 to June 2010 with documented DVT. Patient demographics, admission diagnosis, femoral vein CVL duration were analyzed.

Results: 64 patients were included in the study. Femoral vein CVL was found in 12/64 (19%) patients. All patients with femoral vein CVL had evidence of DVT in the same leg by Doppler ultrasound. Average duration of femoral vein CVL was 11.8 days (2-32d) before diagnosis of DVT.

Conclusion: Femoral vein CVL is a major risk factor DVT. This site should only be used in emergent situations. Once a patient is stablized, the line should be removed or relocated to a better site to avoid this potentially llife threatening complication. The literature on this topic will be reviewed and strategies to reduce DVT in children who require a femoral line will be presented (lovenox prophylaxis, compression boots, etc).

129. Mininvasive Neurosurgical Procedures in Children / Surgery Under MR Skiaskopia

Jiri Ventruba (Brno, Czech Republic); Vlastirad Mach; Jaroslav Sterba (Czech Republic, Children ' s Hospital of Masaryk University Brno)

Introduction: Two types of mininvasive neurosurgical procedures have been performed at Children ' s Hospital of Masaryk University Brno: except endoscopic operations also surgery under MR skiaskopia.

Methods: The open low field (0.2 Tesla) Magnetom Siemens in Children ' s Hospital was installed in 2003. Not only standard MR investigations were performed there but also special operations under MR skiaskopia using nonmagnetic (titanic) instruments.

Results: We performed two types of such procedures: 1st - neurosurgical: Direct operational procedure on the brain under MR skiaskopia with the aim to reach accuratelly pathologic lesion with punctional cannula either with suction of liquid content of cyst lesion (abscess, arachnoid or tumorous cyst, blood haemorrage) and in case of need to place drain catheter into the lesion, or to take a piece of tumorous tissue for histology. 2nd - radiological: Direct procedure on other organs causing thermolesion (for example of metastases in liver). In Janurary 2003 Jiri Ventruba performed the operation under MR skiaskopia as the first neurosurgeon in the so called "east block countries". It was tapping deep situated brain abscess in a very risky girl in severe acute stage of lymphoblastic leukemia. The authors show examples of possibilities of neurosurgical procedures performed under MR skiaskopia (tapping of abscess, evacuation of deep tumorous cyst, inserting drain catheter in the tumour cyst, accurate biopsy of brain tumour).

Conclusions: Surgery under MR skiaskopia is one of a suitable method for managing in pediatric patients. This work has been supported by the contract grant number IGA MZ CR NS 9873-3.

130. Pilomyxoid Astrocytoma: An Unusual Astrocytic Neoplasm

Fernando E. Alonso, BS; Sunil Manjila, MD; Mark L. Cohen, MD; Alan R. Cohen, MD (Cleveland, OH)

Introduction: Pilomyxoid astrocytoma has been recognized as a distinct histopathological entity since 1999. It is classified by WHO as a grade 2 neoplasm, while pilocytic astrocytoma retains a WHO 1 grade. The classic monomorphous histology, younger patient age at diagnosis, shorter time of remission, higher rate of dissemination and lower overall survival are the hallmarks of these tumors. Prognostic factors are not completely understood. We describe our institutional experience with pilomyxoid astrocytomas over the past 10 years.

Methods: A retrospective institutional search was performed from 2000 to 2010 for patients with a final pathological diagnosis of pilomyxoid astrocytoma. Pathological slides were reexamined and an outcome analysis was performed.

Results: We identified 6 surgical patients, 4 males and 2 females. Ages ranged from 4 months to 9 years at time of diagnosis. Tumors varied in location, occurring in the hypothalamus, third ventricle, brainstem and cerebellum. All but one patient, who underwent a gross total resection received adjuvant therapy. Follow-up ranged from 2 to 95 months. One patient had leptomeningeal dissemination. Two patients showed features of both pilocytic and pilomyxoid astrocytomas, while one had anaplastic features.

Conclusions: The treatment of pilomyxoid astrocytoma must be tailored to the clinical scenario. The mixed histopathological features of pilomyxoid astrocytoma and pilocytic astrocytoma in the same lesion is unusual, and suggests possible maturation and transition between these two distinct lesions. We highlight the varied clinical presentations and the association of pilomyxoid astrocytoma in a spectrum from pilocytic to anaplastic astrocytoma.

131. Normal Presentation of an Unusual Case of Radiation Induced Meningiomatosis

Samer K. Elbabaa, MD; Ali G. Saad, MD (Little Rock, AR)

Introduction: Radiation-associated meningiomatosis (RAM) is relatively rare. Meningotheliomatous, transitional, and fibroblastic histologic subtypes are the most common types of RAMs. RAMs of the xanthomatous and chordoid histologic subtypes are exceedingly rare and have not been described in the adult population before. We report a case of RAM displaying various histologic types including xanthomatous and chordoid types. The chordoid type showed loss of 22q12.

Methods: A 28 year old female patient with a history of cranial radiation due to acute myeloid leukemia involving the CNS diagnosed at age of three years-old. The patient does not have stigmata of NF2. At age 24 years, she presented with seizures and visual disturbances. MRI of brain showed a large tuberculum sella dura-based enhancing mass which was resected through a sub-frontal approach. At age of 26, two new dura-based enhancing lesions in the left parietal area were identified. Excision of both lesions was performed.

Results: Pathology of the first meningioma resection showed atypical meningioma with normal cytogenetic study. Pathology of the second Meningioma resections showed xanthomatous meningioma and chordoid meningioma. Cytogenetic studies showed loss of 22q12 (NF2 locus).

Conclusions: This case shows the histologic and cytogenetic progression of RAM. In addition to describing the first case of chordoid and xanthomatous RAMs in the adult population, this case illustrates the cytogenetic progression induced by radiation. Cytogenetic studies of the first resection showed no abnormality while that of the second resection (the chordoid meningioma) showed loss of 22q12. This locus is associated with NF2, although patient does not have stigmata of NF2.

132. A Retrospective Study on the Survivability of Children with Glioblastoma Multiforme from 1976-2005

Maureen A. Darwal, BA; Bradley T. Bagan, MD; Mirza N. Baig, MD, PhD; Chris S. Karas, MD (Des Moines, IA)

Introduction: Glioblastoma multiforme (GBM) historically has been difficult to treat both in adult and pediatric populations. The purpose of this study is to examine survivability trends of pediatric patients diagnosed with a GBM from 1976 to 2005 using the SEER Program.

Methods: SEER*Stat software available at www.seer.cancer.gov/seerstat version 6.6.2 and the database, Incidence - SEER 17 Regs Research Data + Hurricane Katrina Impacted Louisiana Cases, Nov 2009 Sub (1973-2007 varying), were used to collect the survival rates of 49,725 pediatric patients diagnosed with a GBM. The patients were grouped by age as follows: 0-1, 1-4, 5-9, 10-14, 15-19 years old. Survival rates were analyzed at months 1, 3, 6, 9, 12, 24 and 60.

Results: Age group 0-1 had the largest increase (3%) in survival for the 1 month time period, while ages 15-19 saw no change in survival. Age group 0-1 also had the largest increase in survival for the 3 and 6 month time period (8% and 11% respectively). The 9 month mark showed an 11% increase in survival for both age group 0-1 and 1-4. At 12, 24, and 60 months, age group 1-4 had the greatest increases in survival, 14%, 21%, 32% respectively. Overall, the 15-19 age group had the smallest increase in survival (6%) and ages 1-4 had the greatest (13%).

Conclusions: Improvements in the treatment of pediatric GBM over the last 40 years have yielded modest gains in survivability. These gains have been especially notable in the younger ranges of the pediatric population.

133. Pre-Clinical Safety of 124I-8h9 Convection-Enhanced Delivery for Diffuse Intrinsic Pontine Glioma

Neal Luther, MD; Zhiping Zhou, MD; Nai-kong Cheung, MD; Mark Edgar, MD; Mark Souweidane, MD (New York, NY)

Introduction: Diffuse intrinsic pontine glioma (DIPG) is a logical candidate for local convection-enhanced delivery (CED)-mediated therapy. Given the responsiveness of DIPG to radiation therapy and the ability to directly measure 124I activity via PET imaging, the anti-glioma monoclonal antibody 8H9 conjugated to 124I is under consideration for CED-mediated administration in children with DIPG. Pre-clinical experiments evaluating safety and PET imaging following 124I-8H9 CED in rodents and primates were performed.

Methods: Fifteen rats underwent CED of 0.1, 0.3, and 1.0 mCi of 131I-8H9 (n = per dose level) into the pons (concurrent experiments evaluating CED radiation absorption dosimetry estimates showed similar biological doses for 124I and 131I). Animals were evaluated clinically for 3 months and were then euthanized for histology. Two primates underwent CED to the pons: one with gadolinium-bound albumin (Gd-albumin) and the other with 1.0 mCi of 124I-8H9 and Gd-albumin as surrogate tracer. The primates were clinically evaluated for acute and delayed (3-12 months) toxicity.

Results: All but one rat receiving 0.1-1.0 mCi of 131I-8H9 showed no evidence of clinical toxicity. One rat receiving 1.0 mCi of 131I-8H9 suffered severe acute hemiparesis, with necrosis on pathology. Both non-human primates had post-operative MRI confirming successful CED to the pons, and tolerated CED of Gd-albumin and 124I-8H9 without evidence of immediate or delayed clinical toxicity.

Conclusions: These results suggest CED of up to 1.0 mCi of 124I-8H9 is tolerated in the brain stem, and can potentially be set as a target dose in the planning of a clinical trial for children with DIPG.

134. The Transsphenoidal Approach in Pediatric Patients: A Single Institution Experience

Lance S. Governale, MD; Edward R. Laws, MD; Edward R. Smith, MD (Boston, MA)

Introduction: Transsphenoidal surgery is firmly established in adult neurosurgery, but less so in children. Here we review our pediatric transsphenoidal experience with emphasis on indications, technique, outcomes, and complications.

Methods: Retrospective review of all transsphenoidal operations performed at Children's Hospital Boston from 2003-2010.

Results: During the study period, 29 patients (average age 13, range 3-18) underwent 32 operations. Surgical technique evolved from microscopic to endoscopic, and included extended approaches. Operative indications included tumor biopsy, resection, and one chiasmapexy for optic nerve prolapse. Diagnoses included craniopharyngioma (25%), macroadenoma (25%), Rathke's cyst (25%), and microadenoma (9%). Lesions were located primarily in the sella (69%), with suprasellar (16%), cavernous sinus (9%), and clivus/petrous (6%) extension present in the minority of cases. Gross-total resection was achieved in 68% of cases. Among 25 patients with preoperative symptoms, 56% became asymptomatic, 4% improved, and 40% were stable. Postoperative deficits consisted of diabetes insipidus (34%) over half of which were transient, other endocrinopathy (9%), and decreased olfaction (3%). There were no permanent neurologic deficits, infections, CSF leaks, or deaths. Complications included pulmonary embolus (1) and vascular injury/hemorrhage requiring successful diagnostic/therapeutic intervention (3). Of 9 subtotally resected cases (mean follow-up 29 months), 3 underwent reoperation, 3 had radiation therapy, and 3 remain stable. All gross-total resections remain without recurrence (follow-up of 17 months).

Conclusions: Our institutional experience demonstrates that transsphenoidal surgery is feasible in children with rates of resection, tumor control, and complications comparable to craniotomy. These data support the premise that utilization of transsphenoidal surgery will expand in the pediatric population.

POSTER ABSTRACTS

135. An Evaluation of the Efficacy of Curettage as a Primary Surgical Technique for Managing Aneurysmal Bone Cysts of the Spine

Tejas Patil, BS; Mark Krieger, MD; Ira Bowen, BA; Yasser Jeelani, MD; J Gordon McComb, MD (Los Angeles, CA)

Introduction: An aneurysmal bone cyst (ABC) is a rare, highly vascular osteolytic bone lesion. Although histologically benign, they are locally aggressive and invasive. Aneurysmal bone cysts commonly occur in the spine. Management strategies include curettage versus aggressive resection with stabilization. This study evaluates the efficacy of curettage in terms of ABC recurrence and spinal deformity.

Methods: Nine patients with biopsy-proven ABCs of the spine were identified under an IRB-approved protocol. Medical records and imaging studies were reviewed in their entirety. Curettage was performed on all patients in this study.

Results: There were three male patients and six female patients in this study. The median age at diagnosis was 12 years. In all cases the posterior elements were involved. All patients underwent curettage during their initial surgery, and 4/9 patients experienced a recurrence within 2 years, necessitating more aggressive surgery. 3 of these patients required subsequent spine stabilization procedures. Of those that experienced recurrence, 3 of them had lesions in the cervical region. One patient experienced a particularly aggressive form of the tumor for which injections of calcitonin and methylprednisolone were attempted, without success and a repeat resection was required.

Conclusions: Curettage was safe and efficacious for ABCs in 5 out of 9 cases. However, there is a high rate of recurrence with limited resection, necessitating more aggressive surgery with spine stabilization in some patients. Larger studies are needed to evaluate the risk benefit ratio of curettage versus up front aggressive resection with stabilization.

136. Tectal Tumors

Liliana C. Goumnerova, MD, FRCS(C); Christian Strong, BS (Boston, MA)

Introduction: To assess relative efficacy of ETV's and Shunts as the primary intervention in pediatric tectal glioma-derived hydrocephalus and predictors oncologic progression. We studied 60 patients, 33 with primary ETV, 24 with primary Shunts, and 3 followed by MRI. Previous studies have yielded recall bias due to telephone follow-up or selection bias via large sample size imbalances between ETV and Shunt patients. While studies have attempted to deem ETVs superior, many lack internal validity to justify.

Methods: Chi-square analysis was the method used to determine (1) Relative improvement of hydrocephalus symptoms (2) oncologic progression as a function of tumor enhancement and age and (3) complication frequency of each hydrocephalus intervention. Propensity of ETV or Shunt to fail was measured using Kaplan-Meier survival and logrank statistics.

Results: Kaplan-Meier and Logrank analysis was consistent with a statistically significantly lower rate of ETV failure, up to greater than 150 months post-op for each procedure (p=0.0094). Tumor enhancement was not a significant predictor of tumor growth nor was age a predictor of tumor growth or procedure a predictor of hydrocephalus symptom improvement. 25% of Shunt patients and only 9% of ETV patients had complications to surgery (p=0.10).

Conclusion: The study was conclusive for ETV's lower failure propensity as a primary procedure for tumor-derived-hydrocephalus. There is a trend toward significance of ETV as yielding fewer complications. Although we expected tumor enhancement to be a marker for tumor growth, our study was inconclusive. Further research is necessary to evaluate enhancement and growth and symptom improvement.

137. Magnetic Resonance Spectroscopy Profiles of Pediatric Mixed Glioneuronal Tumors

Joffre Olaya, MD; Mark Krieger, MD; Yasser Jeelani, MD; Mark Fedor, MD; Brian Lee, MD; J Gordan McComb, MD; Marvin Nelson, MD; Stefan Bluml, PhD (Los Angeles, CA)

Introduction: Mixed glioneuronal tumors are rare, slowly growing tumors seen most commonly in children. In vivo MR spectroscopy characterizes tissue at a cellular level by quantifying intracellular metabolites. The goal of this study was to review the metabolic features of these tumors.

Methods: A retrospective review of the MR spectroscopy database at Children's Hospital Los Angeles was performed for a nine year period (2001-2010). All MR spectra were acquired with a standard single-voxel PRESS sequence with an echo time of 35ms. Metabolite levels were compared with absolute levels in nontumoral regions, normal controls, and other pediatric brain tumors.

Results: Four children with histologically confirmed mixed glioneuronal tumors underwent MR spectroscopy prior to any intervention. Spectra showed features typically seen in other tumors, such as elevated choline (Cho) and lipids. However, an unusually high N-acetyl-aspartate (NAA) peak was also observed in all patients with mixed glioneuronal tumors, distinguishing them from all other tumors. The NAA to Cho ratio (NAA/Cho) was 2.1 0.5 in mixed glioneuronal tumors vs. 0.6 0.6 ($p<0.001$) in 60 other pediatric tumors.

Conclusions: Mixed glioneuronal tumors have a unique MRS pattern with elevated NAA, in addition to elevated Cho. NAA is present in neurons and axons. The metabolic features of mixed glioneuronal tumors could be useful in distinguishing these tumors from other tumors, and for evaluating residual/recurrent disease.

138. Skull Bone Anomalies Associated with Plexiform Neurofibroma in Children

George Chater Cure, MD (Bogota, Colombia); Mark Souweidane, MD; Samuel Rhee, MD; Kaleb Yohay, MD (New York, NY)

Introduction: Scalp plexiform neurofibromas are rare tumors in children. They are most frequently associated with neurofibromatosis type 1 and rarely associated with skull bone anomalies. The recognition of skull deficiency would be important in management decisions.

Methods: A retrospective review was conducted of patients with plexiform neurofibroma affecting the scalp and/or skull. Patients that had radiographic or clinical evidence of skull deficiency were selected for further detailed analysis.

Results: Four patients with plexiform neurofibroma and associated skull defects were identified. Three of these patients had associated neurofibromatosis type 1. One patient had a temporal bone agenesis, while the other patients had the unifying anatomical feature of affecting the parieto-occipital junction near the asterion. The mean maximal tumor diameter measured 4.5cm(2-8cm). the mean bony defect measured 4 cm(2-10cm). All of the patients underwent tumor removal and cranioplasty with excellent clinical results.

Conclusions: Bony defects of the skull are features that may affect the management decisions in patients with plexiform neurofibroma. Thus, it is advised that all patients being evaluated for these tumors, especially those affecting the retromastoid region, obtain appropriate radiographic imaging to evaluate the integrity of the calvarium. The association of cranial deficiency with a plexiform neurofibroma raises interesting concepts pertaining to the pathogenesis. Long term follow up is recommended in these children for tumor recurrence or further bone resorption.

139. Decompressive Laminectomy and Subtotal Resection of Epidural Lymphoma

Neha Gupta, BS; Mark Krieger, MD; Ira Bowen, BA; Yasser Jeelani, MD; J Gordon McComb, MD (Los Angeles, CA)

Introduction: Epidural metastasis is a rare complication of systemic lymphomas. Cord compression from these lesions is associated with a poor prognosis. Treatment modalities include aggressive surgical resection, decompressive subtotal resection followed by chemotherapy/radiation therapy, and chemotherapy/radiation therapy without surgery. In this study, we evaluated children with metastatic epidural lymphomas treated by subtotal resection followed by chemotherapy and radiation therapy.

Methods: This IRB-approved retrospective review evaluated 20 years of children treated for systemic lymphoma at a major childrens hospital. 5 children with lymphoma presented with cord compression secondary to metastatic disease. Clinical features, management, and outcome of these 5 patients are reviewed.

Results: All 5 patients were treated with surgical decompression and subtotal resection. All 5 received chemotherapy; 3 patients also received radiation. Four patients out of 5 are alive, with follow-up of 26-144 months. 3 patients completely recovered from their neurological symptoms, but 2 had persistent deficits. The degree of recovery was related to the severity and duration of the pre-operative deficits. No patients developed spinal deformity.

Conclusions: Metastatic lymphoma causing cord compression is a rare occurrence. It can be effectively treated with decompressive laminectomy and subtotal resection, followed by chemotherapy and possibly radiation therapy. Neurological deficits are reversible if treatment is undertaken expeditiously.

140. Prevalence, Nature and Frequency of Headache in Children and Adolescents with Shunted Hydrocephalus

Tina Popov, MSN, ACNP; James Drake, MD, FRCSC; Jan Angus, RN, PhD (Toronto, Canada); Patrick McGrath, PhD, FRCS (Halifax, Canada); Bonnie Stevens, RN, PhD (Toronto, Canada)

Introduction: While recurrent headache is a common finding in pediatric hydrocephalus patients with apparently functioning shunts, it has not been rigorously investigated and puts them at risk for the physiological, psychological and emotional consequences of unresolved pain. The purpose of the present study was to determine the prevalence, nature and frequency of headache in this patient population and potential clinical factors associated with headache outside of shunt malfunction.

Methods: Children and adolescents between 7 and 18 years of age, with shunted hydrocephalus, were screened as to whether they had experienced headache during the past month when they visited the outpatient clinic for routine follow-up. Those who responded positively completed a questionnaire based on IHS criteria to classify headaches as tension-type, migraine like or mixed. Demographic information was collected. Data was analyzed using descriptive statistics and logistic and multiple regression.

Results: Of 250 children and adolescents, 63% with apparently functioning shunts reported having headache. Headaches were classified as predominantly migraine like (33%) or mixed (39%). Frequency of reported headaches ranged from 1 day a month to daily. The majority of children reported 1-4 headaches a month. Gender ($p=0.02$) and etiology ($p=0.01$) were associated with headache. No association was found between headache and age, age of insertion, infection and number of shunt revisions.

Conclusions: Headache remote from shunt malfunction is a common and significant problem for these children and adolescents. Strategies to identify, treat and potentially prevent headache need to be developed.

141. Treating Rett Dystonia Patients with Intrathecal Baclofen

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Introduction: Intrathecal Baclofen (ITB) is used to treat spasticity and dystonia but little is described in literature for its use in Rett Syndrome (RS), despite their natural history of progressive musculoskeletal deformity correlating and functional decline with aging. RS dystonia contributes to pain, difficulties with caregiving/ADLs and limits function such as reaching and gait. Often the severity of dystonia requires higher ITB doses delivery at a higher spinal level which cannot be achieved with bolus trials. We report our experience in the treatment of RS dystonia with ITB.

Methods: Three patients with RS, ages 14-16, were trialed with ITB. Two patients underwent continuous intrathecal baclofen infusion trial and one underwent a bolus trial. All patients were assessed for functional gains, comfort, and ease of ADLs. All three underwent implantation of a permanent ITB pump connected to a C1 catheter after showing improvement in the trial.

Results: All three patients exhibited significant reduction in muscle tone with improvement in comfort and ease of ADLs. In the two catheter trials, preservation of weight bearing ability was demonstrated despite significant tone reduction which was a primary goal of the parent. Similarly, atypical functional use of upper limbs for grasping was maintained despite significant tone reduction in one child. Doses of ITB were 370, 576, and 615 micrograms/day.

Conclusions: ITB is an effective treatment for RS dystonia, as they experience a significant improvement in the quality of life while maintaining or improving a pre-intervention level of function. No RS specific side effects were noted with this series.

142. Do Continuous Intrathecal Baclofen Trials Effectively Predict Functional Gains from Chronic Intrathecal Baclofen Therapy in Children?

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Introduction: Intrathecal baclofen therapy has been used since 1992 for the treatment of spasticity and dystonia. Deciding to embark on it baclofen therapy partially depends upon the ability to predict functional improvement from this therapy prior to the investment in the pump implantation. A continuous trial of it baclofen by temporary delivery mechanisms has been the mainstay of assessing future efficacy prior to implant surgery despite little evidence of the accuracy of this predictive method.

Methods: We reviewed the records and videos of 18 continuous intrathecal baclofen trials to assess the ability of the trial to predict functional gains. We examined each trial for subjective functional gains and peri-procedural adverse events such as pain, nausea, lethargy and headache.

Results: 11 of the 18 trials exhibited some functional gain. All 9 of the patients that went on to have pumps implanted continued to exhibit the functional gains noted in the trial without persistence of complications.

Conclusion: Intrathecal baclofen trials are able to predict functional gains of chronic intrathecal baclofen therapy in children in more than half of the patients tested. This information may be used to predict efficacy when it baclofen is chosen for more improvements other than comfort, ease of ADLs and deformity prevention. However, adverse effects, along with extended hospital stay, may complicate the acquisition of such information in approximately half the patients.

143. Current and Future Indications for Deep Brain Stimulation in Pediatric Populations

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Introduction: Deep brain stimulation (DBS) has proven to be an effective and safe treatment option in adults with various advanced and treatment-refractory conditions. However, children can also be afflicted by functionally incapacitating neurological conditions that remain refractory despite the clinicians' best efforts. In such cases, DBS offers an additional treatment alternative. We review our institutional experience with DBS in children, and discuss current and future indications for DBS in the pediatric population.

Methods: Since 2001, we have treated 6 children (mean age=13 years) with DBS procedures. Clinical indications included 3 patients with DYT1 dystonia, 1 with secondary dystonia (viral encephalitis), 1 with glutaric acidemia Type 1, and 1 patient who presented with dystonia of unknown origin.

Results: Surgery in this series included bilateral globus pallidus interna (GPi) DBS insertion in 4 patients and bilateral subthalamic zona inserta DBS insertion in 1 patient. One patient underwent revision of their GPi DBS electrodes and pulse generator. No procedural or postoperative complications were observed. The mean follow-up duration for available patients was 32 months (range 1-77 months). No DBS-related side effects were documented under normal stimulation parameters. Clinical improvement was observed in 4/5 patients in whom follow-up was available.

Conclusions: We conclude that DBS in children can and should be considered a valid and effective treatment option for selective functionally-incapacitating neurological disorders. At present, the limited literature and our own experience support the use of DBS for movement disorders in highly selective children, with ongoing research exploring additional, exciting indications such as psychiatric disorders, epilepsy, and spasticity.

144. Bilateral Occipital Nerve Decompression for Chronic Daily Headache in Children

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Introduction: Approximately 1% of the pediatric population suffers with Chronic Daily Headache (CDH). CDH can be a debilitating condition that affects both the child and family's quality of life. In addition to pain, this condition impacts the child's academic performance and psychosocial function at a critical time of development. Recent literature in adults has shown efficacy for Occipital Nerve Decompression (OND) for headache. We report our application of the technique to CDH in children.

Methods: 9 children and young adults ranging in age from 11-25 underwent 10 bilateral occipital nerve decompressions over a 1.5 year period. All had failed medical management, local blocks, and physical therapy. Both endoscopic and open techniques were used. Average daily pain scores and quality of life assessments were made before and after decompression.

Results: 5 of the 10 patients undergoing OND had a drop in their average daily pain score for 50% or better. One patient, who only experienced temporary relief endoscopically, experienced full relief from the open procedure. 3 of the 10 patients experienced complete headache relief. There were no complications.

Conclusions: OND may offer relief in CDH patients that fail medical, local and manipulation therapies to control their headache. More study is needed to assess the ideal outcome measure, optimal surgical technique, and proper patient selection.

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November 29 – December 2, 2011
Hilton Austin
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