



38th Annual Meeting of the AANS/CNS Section on Pediatric Neurological Surgery

December 1–4, 2009
Boston Marriott Copley Place
Boston, Massachusetts

2009 PROGRAM BOOK

Boston

Jointly Sponsored by the AANS



American
Association of
Neurological
Surgeons



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Claim CME Credit the Easy Way

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

Do not self-report CME credit for the 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

December 1 – 4, 2009, Boston, Massachusetts

This activity has been planned and implemented in accordance with the Essentials Areas and Politics 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 educational activity for a maximum of 28.25 *AMA PRA Category 1 Credits*[™]. Physicians should only claim credit commensurate with the extent of their participation in the educational activity.

For the pre-meeting nurse seminar on December 1st, this continuing nursing education activity is approved by the Illinois Nurses Association, an accredited approver by the American Nurses Credentialing Center's Commission on Accreditation.

JOINT SPONSORSHIP DISCLAIMERS

The material presented at the 2009 AANS/CNS Section on Pediatric Neurological Surgery Annual Meeting has been made available by the AANS/CNS Section on Pediatric Neurological Surgery and the AANS for educational purposes only. The material is not intended to represent the only, nor necessarily the best, method or procedure appropriate for medical situations discussed, but rather is intended to present an approach, view, statement or opinion of the faculty, which may be helpful to others who face similar situations.

Neither the content (whether written or oral) of any course, seminar or other presentation in the program, nor the use of 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.
- 3) Explain the new techniques in the surgical treatment of pediatric and congenital neurosurgical disorders.

ANNUAL MEETING SITES

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



FUTURE MEETING SITE

2010 CLEVELAND

November 30 – December 3, 2010

JOINT SECTION ON PEDIATRIC NEUROLOGICAL SURGERY

OFFICERS AND COMMITTEES

Pediatric Section Chairs

1972-73	Robert L. McLaurin	1987-89	David G. McLone
1973-74	M. Peter Sayers	1989-91	Donald H. Reigel
1974-75	Frank Anderson	1991-93	R. Michael Scott
1975-76	Kenneth Shulman	1993-95	Arthur Marlin
1976-77	E. Bruce Hendrick	1995-97	Harold L. Rekate
1977-78	Frank Nulsen	1997-99	Marion L. Walker
1978-79	Luis Schut	1999-01	John P. Laurent
1979-81	Fred J. Epstein	2001-03	Thomas G. Luerksen
1981-83	Joan L. Venes	2003-05	Andrew D. Parent
1983-85	Harold J. Hoffman	2005-07	Rick Abbott
1985-87	William R. Cheek	2007-09	Jeffrey H. Wisoff
		2009-11	Ann-Christine Duhaime

Officers

Chair	Ann-Christine Duhaime, MD (2009-2011)
Chair-Elect	Alan R. Cohen, MD, FACS (2009-2011)
Secretary	Bruce A. Kaufman, MD FACS (2009 - 2011)
Treasurer	Bruce A. Kaufman, MD, FACS (2007-2009)
Membership Chair	Sarah J. Gaskill, MD, FACS (2009-2011)
Past Chair	Jeffrey H. Wisoff, MD (2009-2011)
Members at Large	James M. Drake, MD (2008-2010) Michael H. Handler, MD, FACS (2008-2010) David P. Gruber, MD (2009-2011) John Ragheb, MD, FACS (2009-2011)

Standing Committees

Nominating Committee	Jeffrey H. Wisoff, MD, Chair (2009) Rick Abbott, MD (2007) Andrew D. Parent, MD (2005)
Rules and Regulations Committee: (3 members serving 2 years)	Nathan Selden, MD, PhD, Chair (2004-2009) John C. Wellons III, MD (2008-2010) Elizabeth Tyler-Kabara, MD, PhD (2008-2010)
Membership Committee: (3 members serving 2 years)	Mark R. Proctor, MD, Chair (2007-2009) Robin M. Bowman, MD (2008-2010) David H. Harter, MD (2008-2010)

Ad Hoc Committees

Education Committee George I. Jallo, MD, Chair (2009)

Program and Continuing Medical Education Subcommittee:

(7 members: Chair and Vice Chair serve two years. Vice Chair assumes chair at next sequence. Other members are the Annual Meeting Chair, two Ex Officio members: the Section Chair and Treasurer)

Mark D. Krieger, MD, Chair (2009)
David P. Gruber, MD (2008, Spokane)
Liliana C. Goumnerova, MD, FRCS (C) (2009, Boston)
Shenandoah Robinson, MD (2010, Cleveland)

Examination Questions Committee Corey Raffel, MD, PHD (2006)

Publications Committee: (3 members serving 2 years)

Douglas L. Brockmeyer, MD, Chair (2006-2009)
Ann M. Ritter, MD, Vice Chair (2008-2010)
Richard C. E. Anderson, MD (2008-2010)
Jeffrey R. Leonard, MD (2008-2010)
Peter P. Sun, MD (2008-2010)

Training Committee Jeffrey P. Blount, MD, FACS (2006)

Traveling Fellowship: (3 members) R. Michael Scott, MD, Chair
Bermans J. Iskandar, MD (2008-2010)
Matthew D. Smyth, MD (2008-2010)

Lifetime Achievement Award: (Most recent Ex-Chair of the Section)

Jeffrey H. Wisoff, MD (2009)

Transition of Care Committee Harold L. Rekate, MD, Chair (2007)

Research Committee John R. W. Kestle, MD, Chair (2007)
Nalin Gupta, MD, PHD
Ann-Christine Duhaime, MD

Representatives and Liaisons

ISPN Liaison George I. Jallo, MD (2006)

ASPN Liaison Liliana C. Goumnerova, MD, FRCS (C) (2006)

Liaison to AAP Section of Neurological Surgery (SONS) Mark Dias, MD (2009)

Liaison to Joint Section on Trauma Matthew Smyth, MD (2008)

Joint Council of State Neurosurgical Societies Cathy Mazzola, MD (2008)

Quality Assurance Committee Paul A. Grabb, MD (1999)
Sarah J. Gaskill, MD, FACS (1999)
James M. Drake, MD (1999)

Washington Committee, AANS/CNS Jeffrey H. Wisoff, MD (2009)

Coding and Reimbursement Committee Frederick A. Boop, MD, FACS (2004)
David P. Gruber, MD (2006)

Education and Practice Management Committee, AANS Sarah J. Gaskill, MD, FACS (2006)

Joint Guidelines Committee

John Ragheb, MD, FACS, Chair (2007-2009)
Ann Marie Flannery, MD (2008-2010)
Benjamin C. Warf, MD (2008-2010)
Sarah J. Gaskill, MD, FACS (2008-2010)

2009 RAIMONDI LECTURER



Charles D. Stiles, PhD received his PhD in biochemistry from the University of Tennessee, Oak Ridge and conducted postdoctoral research at the University of California San Diego. In 1976, he joined the faculty of Harvard Medical School as an Assistant Professor of Microbiology and Molecular Genetics. He serves now as Professor of Microbiology and Molecular Genetics at Harvard Medical School and

Co-Director of the CNS Cancer Program at Dana-Farber/Harvard Cancer Center.

Dr. Stiles is well known for his early work that established functional relationships between cancer-causing genes (oncogenes) and the animal cell growth factors (for example refs 1-3). For the past 10 years, his research group has focused on the molecular mechanisms of fate choice in neural progenitor cells and developmental lesions in the fate choice process that give rise to brain cancers (for example refs 4-6).

Dr. Stiles has received various awards recognizing his scientific work including the American Cancer Society Faculty Research Award, the American Association for Cancer Research prize for meritorious achievement by a young investigator and the Cori Award from the Roswell Park Memorial Institute. He has also received prizes for both teaching and mentoring from the graduate program in Biochemistry and Biomedical Sciences at Harvard Medical School.

Dr. Stiles serves on the Scientific Advisory Boards of The Brain Science Foundation, the Susan Sontag Foundation, and the California Institute for Regenerative Medicine. He is former chair of the National Institutes of Health study section on Neurogenesis and Cell Fate and a consultant for the Dana-Farber/Novartis Program in Drug Discovery. Dr. Stiles is the author of more than 100 peer-reviewed scientific articles and 28 book chapters and symposia.

Representative Publications

(*indicates corresponding or co-corresponding author)

1. Cochran BH, Reffel AR, Stiles CD*. Molecular cloning of gene sequences regulated by platelet-derived growth factor. *Cell* 1983; 33: 939-947.
2. Kelly K, Cochran BH, Stiles CD and Leder P. Cell-specific regulation of the c-myc gene by lymphocyte mitogens and platelet-derived growth factor. *Cell*. 1983; 35: 603-10
3. Armelin HA, Armelin MCS, Kelly K, Stewart T, Leder P, Cochran BH, Stiles CD*. Functional role for c-myc in mitogenic response to platelet-derived growth factor. *Nature* 1984; 310:655-660.
4. Lu QR, Sun T, Zhu Z, Ma N, Garcia M, Stiles CD* and Rowitch DH. Common developmental requirement for Olig function indicates a motor neuron/oligodendrocyte connection. *Cell*. 2002; 109: 75-86.
5. Arnett HA, Fancy SPJ, Alberta JA, Zhao C, Plant SR, Kaing S, Raine CS, Rowitch DH, Franklin RJM and Stiles CD*. The bHLH Transcription Factor Olig1 is Required for Repair of Demyelinated Lesions in the CNS. *Science* 2004; 17;306(5704):2111-5.
6. Ligon KL, Huillard E, Mehta SM, Kesari S, Liu J, Alberta J, Bachoo RB, Kane M, Louis DN, DePinho RA, Anderson DJ, Stiles CD*, Rowitch DH. Olig2-regulated lineage-restricted pathway controls replication competence in neural stem cells and malignant glioma. *Neuron* 2007; 53(4):503-17.

RAIMONDI LECTURERS

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

MATSON MEMORIAL LECTURERS

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

FRANC D. INGRAHAM DISTINGUISHED SERVICE AWARD RECIPIENTS

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

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 Hematoma 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

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

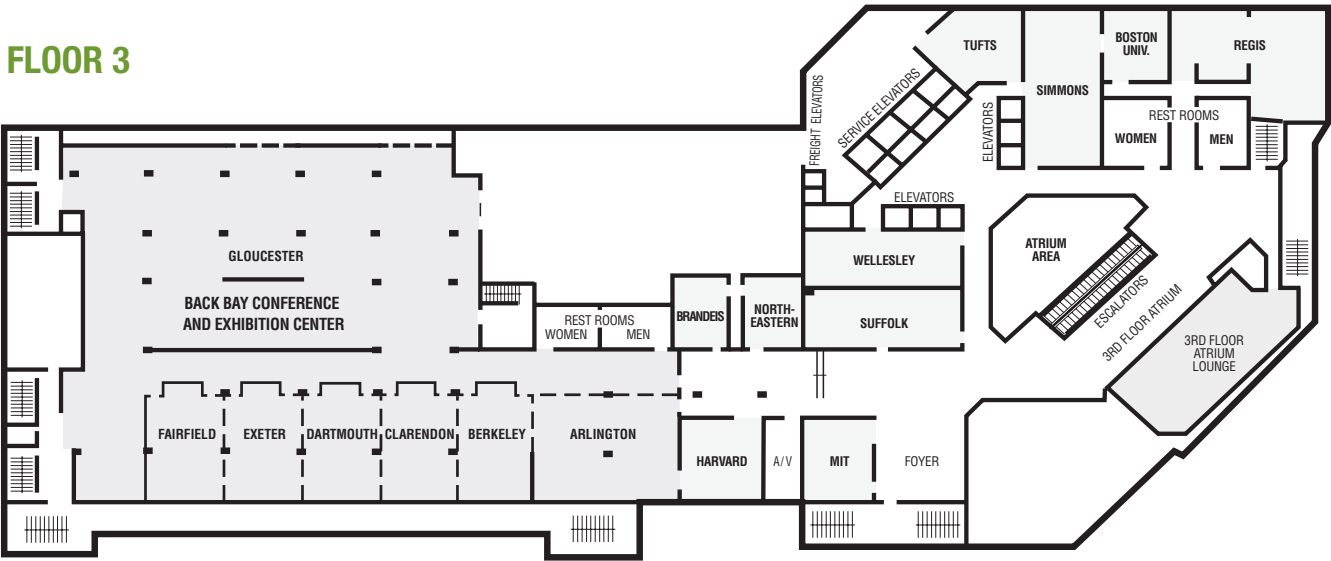
2008 ELLEN R. AIR

A Longitudinal Comparison of Pre- and Postoperative DTI Parameters in Young Hydrocephalic Children



FLOOR PLAN – THE BOSTON MARRIOTT COPLEY PLACE

FLOOR 3



FLOOR 4

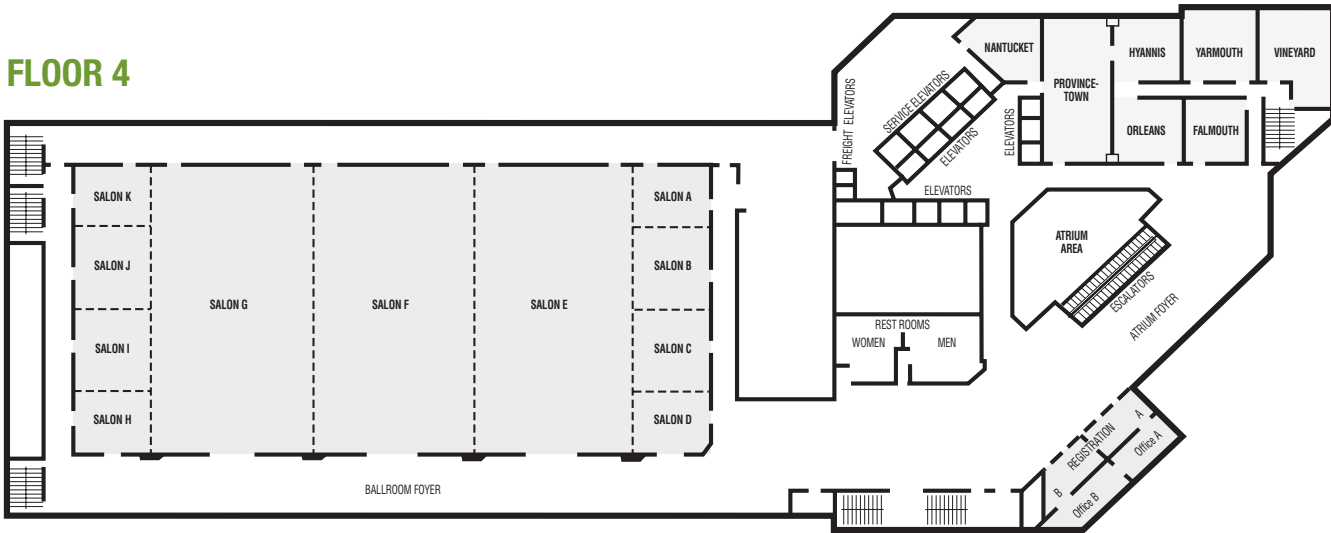
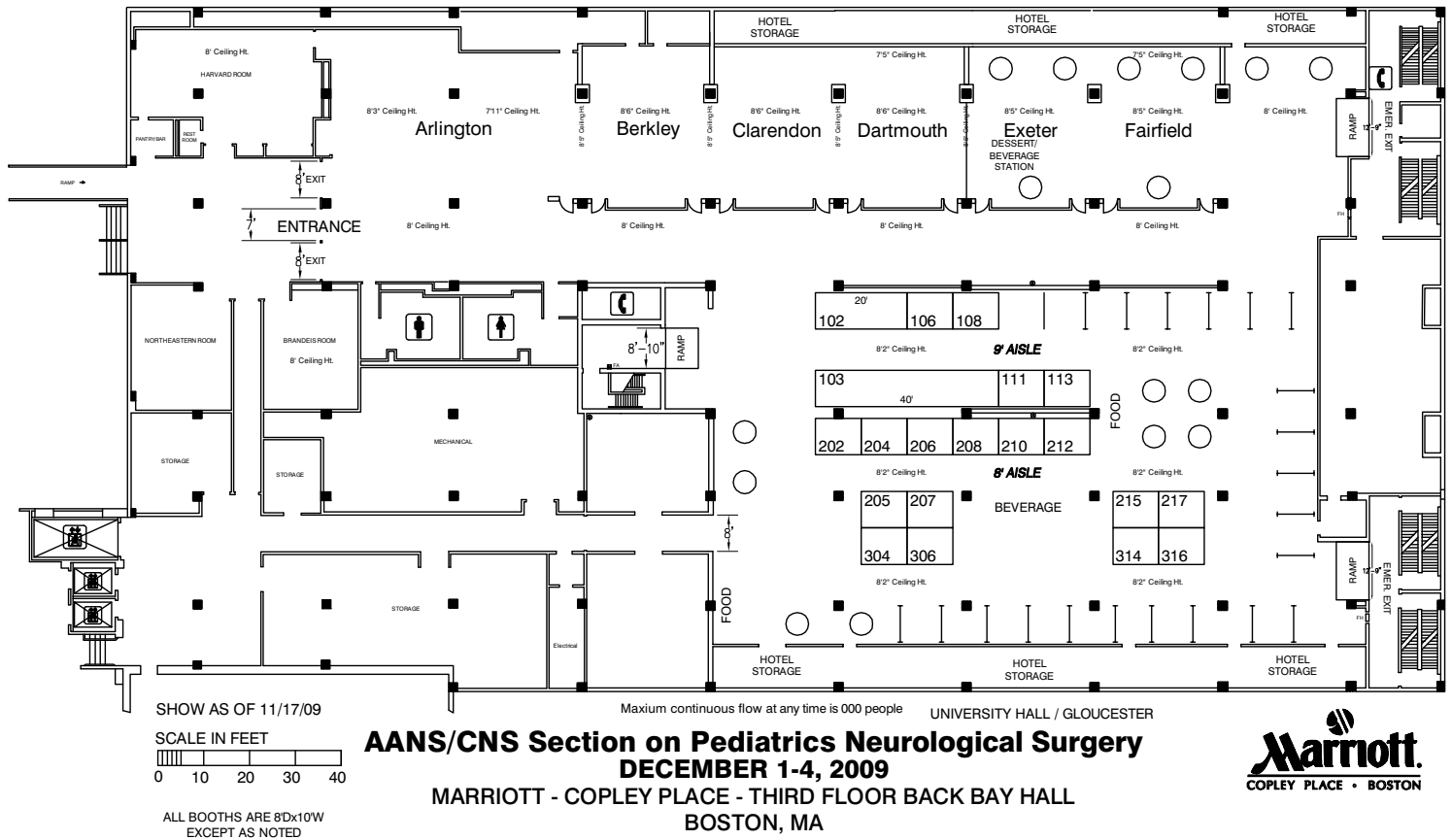


EXHIBIT FLOOR PLAN – THE BOSTON MARRIOTT COPLEY PLACE



EXHIBITOR LISTING

The AANS/CNS Section on Pediatric Neurological Surgery gratefully recognizes the support of these exhibitors. *As of November 16, 2009*

Aesculap Inc.

3773 Corporate Parkway
Center Valley, PA 18034
(610) 797-9300
www.aesculapusa.com
Booth: 300

Clarus Medical, LLC

1000 Boone Avenue North
Minneapolis, MN 55427
(763) 525-8400
www.clarus-medical.com
Booth: 119

Codman, a Johnson & Johnson company

325 Paramount Drive
Raynham, MA 02767
(508) 880-8100
www.codman.com
Booth: 102

HCA Physician Recruitment

3 Maryland Farms
Suite 100
Brentwood, TN 37027
(615) 373-7571
www.hca-kids.com
Booth: 302

Hydrocephalus Association

870 Market Street
Suite 705
San Francisco, CA 94102
(415) 732-7040
www.hydroassoc.org
Booth: 113

IMRIS

100-1370 Sony Place
Winnipeg, MB R3T-1N5
Canada
(204) 480-7070
www.imris.com
Booth: 207

Integra LifeSciences

311 Enterprise Drive
Plainsboro, NJ 08536
(609) 275-0500
www.integra-ls.com
Booth: 200

KLS - Martin , LP

P O Box 16369
Jacksonville, FL 32245
(904) 641-7746
www.klsmartin.com
Booth: 218

Lippincott Williams & Wilkins

231 Allen Road
Porter Corners, NY 12859
(518) 258-9234
www.lww.com
Booth: 205

Medtronic, Inc.

710 Medtronic Parkway
Minneapolis, MN 55432
(800) 328-2518
www.medtronic.com
Booth: 101

Neurologica Corporation

14 Electronics Avenue
Danvers, MA 01923
(978) 564-8500
www.neurologica.com
Booth: 202

NICO Corp.

Suite 203
9190 Priority Way West Drive
Indianapolis, IN 46256
(317) 660-7118
www.niconeuro.com
Booth: 201

Omni

Building 100
One Kendall Square
Cambridge, MA 02139
(617) 551-8444
www.omni-guide.com
Booth: 108

Pro Med Instruments

Suite 101
4529 SE 16th Place
Cape Coral, FL 33904
(239) 369-2310
www.headrest.de
Booth: 210

RosmanSearch, Inc.

30799 Pinetree Road
#250
Pepper Pike, OH 44124
(216) 256-9020
www.rosmansearch.com
Booth: 204

Stryker

Suite 200
750 Trade Center Way
Portage, MI 49002
(269) 324-5346
www.stryker.com/microimplants
Booth: 320

Synthes CMF

1301 Goshen Parkway
West Chester, PA 19380
(610) 719-6500
www.synthes.com
Booth: 118

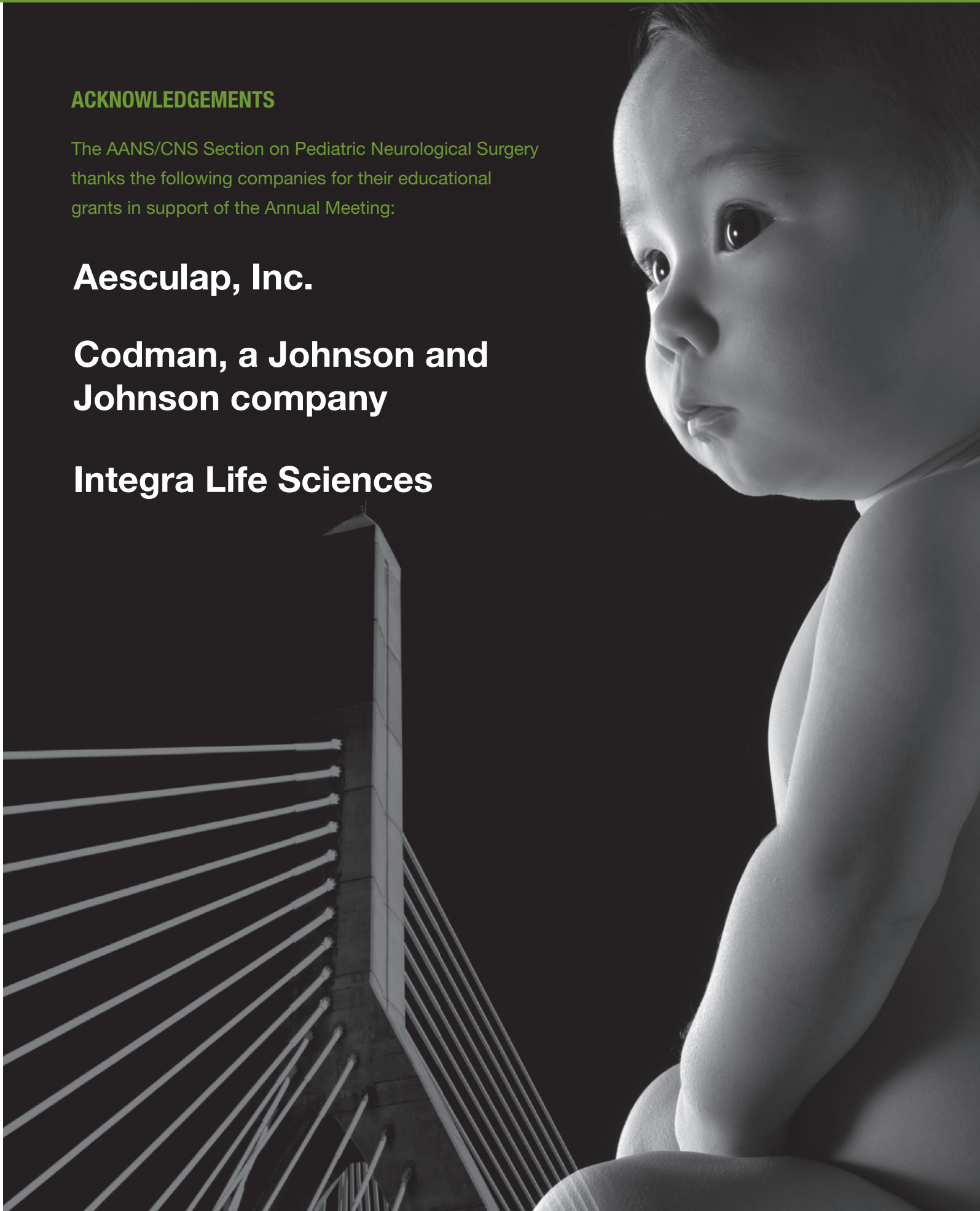
ACKNOWLEDGEMENTS

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

Aesculap, Inc.

**Codman, a Johnson and
Johnson company**

Integra Life Sciences



PROGRAM AT-A-GLANCE

	TIME	EVENT	LOCATION
TUESDAY December 1	7:00 AM – 7:00 PM	Registration	Registration B
	8:00 AM – 5:00 PM	Pre-Meeting Nurses', Physician's Assistants' and Physician Extenders' Seminar	Wellesley
	4:00 – 6:30 PM	Speaker Ready Room	Yarmouth Room
	6:30 – 8:00 PM	Opening Reception	3rd Floor Atrium
WEDNESDAY December 2	7:00 AM – 5:30 PM	Registration	Registration B
	7:00 – 8:00 AM	Continental Breakfast in Exhibit Hall	Gloucester
	7:00 AM – 5:30 PM	Exhibit & Poster Viewing	Gloucester
	7:00 AM – 4:00 PM	Speaker Ready Room	Yarmouth Room
	8:00 AM – 12:00 PM	Scientific Sessions	Salon E
	10:00 – 10:30 AM	Beverage Break in Exhibit Hall	Gloucester
	12:00 – 1:00 PM	Lunch & Poster Viewing in Exhibit Hall	Gloucester
	1:00 – 4:30 PM	Scientific Sessions	Salon E
	2:30 – 3:00 PM	Beverage Break in Exhibit Hall	Gloucester
	4:30 – 5:30 PM	Wine & Cheese Reception in Exhibit Hall	Gloucester
THURSDAY December 3	7:00 AM – 4:00 PM	Registration	Registration B
	7:00 – 8:00 AM	Continental Breakfast in Exhibit Hall	Gloucester
	7:00 AM – 3:30 PM	Exhibit & Poster Viewing	Gloucester
	7:00 AM – 4:00 PM	Speaker Ready Room	Yarmouth Room
	8:00 AM – 12:00 PM	Scientific Sessions	Salon E
	10:10 – 10:40 AM	Beverage Break in Exhibit Hall	Gloucester
	12:00 – 1:00 PM	Lunch & Poster Viewing in Exhibit Hall	Gloucester
	1:00 – 5:00 PM	Scientific Sessions	Salon E
	2:30 – 3:00 PM	Beverage Break in Exhibit Hall	Gloucester
FRIDAY December 4	7:00 AM – 3:00 PM	Registration	Registration B
	7:00 – 8:00 AM	Continental Breakfast in Exhibit Hall	Gloucester
	7:00 – 10:30 AM	Exhibit & Poster Viewing	Gloucester
	7:00 AM – 4:00 PM	Speaker Ready Room	Yarmouth Room
	8:00 AM – 12:00 PM	Scientific Sessions	Salon E
	10:00 – 10:30 AM	Beverage Break in Exhibit Hall	Gloucester
	12:00 – 1:00 PM	Lunch (optional afternoon Symposium)	Clarendon
	1:00 – 4:00 PM	NF1 Symposium (optional attendance)	Salon E

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

PROGRAM DESCRIPTIONS

The open scientific sessions provide participants exposure to the latest in research and groundbreaking information available on neurosurgical topics. The Raimondi lecture will be given by Charles Stiles, PhD and is entitled *Transcription Factors and Malignant Glioma in Mouse and Man*. Educational programming includes topics such as Hydrocephalus, Neoplasms, Developmental Anomalies and Functional, Spasticity and Peripheral Nerve.

Nursing Seminar

A pre-meeting Nurses' Seminar will be held on Tuesday, December 1 from 8:00 AM – 5:00 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. Nursing contact hours have been applied for. Please contact the Illinois Nurses Association for further information.

Learning Objectives

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

Advanced Fetal Care Center

- List three prenatal fetal diagnoses seen by neurosurgery consultants in the Advanced Fetal Care Center (AFCC)
- Describe imaging modalities used in prenatal diagnosis

ETV with Choroid Plexus Cauterization

- Describe why there has been a resurgence in ETV
- Describe the indications for endoscopic third ventriculostomies and cauterization of the choroid plexus

Osteoid Osteomas & Pediatric Discs

- Define the clinical presentation of both disc herniation and osteoid osteoma in the adult and pediatric population
- Explain the various treatment modalities, including surgical intervention for disc herniation and osteoid osteoma in the pediatric population

Ethics Panel

- Identify the salient ethical principles in each case presented
- Delineate the cultural, ethnic, and spiritual/religious factors which influence the decision making in the cases presented

Posterior Fossa Tumors

- Identify the different types of posterior fossa tumor
- Recognize their presentation
- Manage post-operative complications

Vasculitis / Multiple Sclerosis

- Describe the physiologic process of demyelination
- Describe the diagnosis and treatment of various neurological demyelinating disorders
- State the nursing implications associated with caring for a child with a demyelinating disorder

Intraventricular Baclofen

- Define and recognize three different types of conditions that may benefit from intraventricular baclofen infusion
- Identify when intraventricular baclofen (IVB) treatment should be used
- Recognize the risks of intraventricular baclofen infusion

Chiari Malformations

- Understand the anatomy of the posterior fossa
- Differentiate between the types of Chiari malformations
- List different types of treatments

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, December 1st from 6:30 – 8:00 PM at The Boston Marriott Copley Place in the 3rd Floor Atrium. Enjoy spending the evening with friends and colleagues over a wonderful assortment of hors d'oeuvres and drinks. All registered attendees and registered guests/ spouses receive one complimentary ticket to this event.



PROGRAM SCHEDULE

TUESDAY, DECEMBER 1

7:00 AM – 7:00 PM

Registration

7:00 – 10:00 AM

ABPNS Board Meeting

Clarendon Room

8:00 AM – 5:00 PM

Nurses', Physician's Assistants' and Physician Extenders' Seminar

Wellesley Room

10:00 AM – 2:30 PM

ABPNS Exam

Dartmouth Room

12:00 – 4:30 PM

AANS/CNS Section on Pediatric Neurological Surgery Executive Committee Meeting

Simmons Room

4:30 – 6:00 PM

Education Committee Meeting

Suffolk Room

6:30 – 8:00 PM

Opening Reception

3rd Floor Atrium

Nurses', Physician's Assistants' and Physician Extenders' Seminar

Wellesley Room

8:00 AM

Welcome and Introduction

Liliana Goumnerova, MD, FRCS(C)

Ann-Christine Duhaime, MD

8:00 – 8:40 AM

Advanced Fetal Care Center (AFCC)

Donna Morash, RN

8:40 – 9:20 AM

ETV with Choroid Plexus Cauterization

Barbara A. Devorin, APRN, BC, PNP

9:20 – 10:00 AM

Osteoid Osteomas & Pediatric Discs

Michelle Parker, MS, CPNP

10:00 – 10:20 AM

Break

10:20 AM – 12:00 PM

Ethics Panel Discussion

David K. Urion, MD

Christine Mitchell, RN, MS, MTS, FAAN

Kathleen Callahan, RN, MS, CCM

Patricia Reidy, MSN, PNP

12:00 – 1:00 PM

Lunch

Suffolk Room

1:00 – 2:00 PM

Posterior Fossa Tumors

R. Michael Scott, MD

2:00 – 2:40 PM

Vasculitis/MS

Lisa Duffy, CPNP-PC, CNRN

2:40 – 3:00 PM

Break

3:00 – 3:40 PM

Intraventricular Baclofen

Susan S. Ferson, MSN, CPNP

3:40 – 4:30 PM

Chiari Malformations

Ethel (Rere) Dawley, MSN, FNP

4:30 – 5:00 PM

Wrap-up and Evaluations

WEDNESDAY, DECEMBER 2, 2009

7:00 AM – 5:30 PM

Registration

Registration B, 4th Floor

7:00 – 8:00 AM

Continental Breakfast

Gloucester Room

7:00 – 8:00 AM

ASPN Mission and Goals Meeting

Exeter Room

7:00 – 8:00 AM

SONS Executive Committee Meeting

Clarendon Room

7:00 AM – 4:00 PM

Speaker Ready Room

Yarmouth Room

8:00 – 8:05 AM

Welcome and Opening Remarks

Salon E

Ann-Christine Duhaime, MD

PROGRAM SCHEDULE

8:05 – 8:30 AM

Cervical Spine Fusion and Instrumentation in Children

Arnold H. Menezes, MD

Douglas L. Brockmeyer, MD

Moderator: Mark R. Proctor, MD

8:30 – 10:00 AM

Session I: Hydrocephalus

Moderators: Mark R. Proctor, MD; David I. Sandberg, MD

8:30 – 8:39 AM

1. Variations among Experienced Pediatric Neurosurgeons in Treating Hydrocephalus

A. Leland Albright, MD (Madison, WI)

8:40 – 8:49 AM

2. The Association between Cerebrospinal Fluid Shunting and Hearing Loss in Children with Medulloblastoma

Daniel J. Guillaume, MD, MS; Kristin Knight, MS; Edward Neuwelt, MD (Portland, OR)

8:50 – 8:59 AM

3. The Dynamics of Brain and CSF Growth in the Developing Hydrocephalic Mouse

Jason G. Mandell, MS; Thomas Neuberger, PhD; Corina S. Drapaca, PhD; Andrew G. Webb, PhD; Steven J. Schiff, MD, PhD (University Park, PA)

9:00 – 9:09 AM

4. Vascular Endothelial Growth Factor as a Potential Target for Hydrocephalus

Joseph R. Madsen, MD; Joon W. Shim, PhD; Johanna Sandlund, MD, PhD; Mustafa Q. Hameed, MD; Susan Connors, BS; Sandra Smith, MS; Laurel Fleming, BA; Gani Abazi, MD, MPH; Michael Klagsbrun, PhD (Boston, MA)

9:10 – 9:19 AM

5. Effectiveness of a Clinical Pathway for Patients with Cerebrospinal Fluid Shunt

Joshua J. Chern, MD, PhD; Charles G. Macias, MD, MPH; Andrew Jea, MD; Daniel J. Curry, MD; Thomas G. Luerssen, MD; William E. Whitehead, MD, MPH (Houston, TX)

9:20 – 9:29 AM

6. Endoscopic Third Ventriculostomy for Shunt Malfunction: What to do with the Shunt

Julian J. Lin, MD; David Neils, MD (Peoria, IL)

9:30 – 9:39 AM

7. The Effect of MRI's on Programmable Shunts: A Retrospective Study

Keyne K. Johnson, MD; Valleria Bagley, MD; Jogi Pattisapu, MD; Christopher Gegg, MD; Greg Olavarria, MD (Orlando, FL)

9:40 – 9:49 AM

8. Shunting in Chronic Hydrocephalus Induces VEGFR-2 and Blood Vessel Density Changes in the Hippocampus

Mark Luciano, MD, PhD; Abhishek Deshpande, BS; Stephen Dombrowski, PhD; Natalie Krajcir, BA; Nicholas Zingales; Jun Yang, MD (Cleveland, OH)

9:50 – 9:59 AM

9. Imaging Characteristics Were Not Predictive of Ventriculosubgaleal Shunt Conversion in VLBW Infants with Post-Hemorrhagic Hydrocephalus

Sam A. McBride; Amelia K. Boehme; Chevis N. Shannon, MBA; Jay Riva-Cambrin, MD; Curtis J. Rozzelle, MD; Jeffrey P. Blount, MD; Jerry Oakes, MD; Waldemar A. Carlo, MD; John C. Wellons III, MD (Birmingham, AL)

10:00 – 10:30 AM

Beverage Break in the Exhibit Hall

Gloucester Room

10:30 AM – 12:00 PM

Session II: Tumors

Moderators: Jodi L. Smith, MD, PhD; Robert F. Keating, MD

10:30 – 10:39 AM

10. Surgical Management of Giant Pediatric Craniopharyngiomas

Robert E. Elliott, MD; Kevin Hsieh, MD; Jeffrey H. Wisoff, MD (New York, NY)

10:40 – 10:49 AM

11. Safety and Utility of Scheduled Non-Narcotic Analgesic Medications in Children Undergoing Craniotomy for Brain Tumor

David F. Bauer, MD; Alicia M. Waters, BS; R. Shane Tubbs, PhD, PA-C; Curtis J. Rozzelle, MD; John C. Wellons III, MD; Jeffrey P. Blount, MD; W Jerry Oakes, MD (Birmingham, AL)

10:50 – 10:59 AM

12. Endonasal Endoscopic Assisted Transphenoidal Resection of Sellar/Suprasellar Lesions in the Pediatric Population

Shaan Raza, MD; James Frazier, MD; Kaisorn Chaichana, MD; Violette Recinos, MD; Alfredo Quinones-Hinojosa, MD; George I. Jallo, MD (Baltimore, MD)

11:00 – 11:09 AM

13. Clinical Management and Seizure Control in Pediatric Gangliogliomas

Chiachien J. Wang, PhD; J. Gordon McComb, MD; Mark D. Krieger, MD (Los Angeles, CA)

PROGRAM SCHEDULE

11:10 – 11:19 AM

14. Recurrence Risk Associated with Immediate and Delayed Postoperative MRI Changes in Children with Pilocytic Astrocytoma

Wendy M. Goldstein, BS; Mark D. Krieger, MD; J. Gordon McComb, MD (Los Angeles, CA)

11:20 – 11:29 AM

15. Seizure Outcome Following Surgical Resection of Dysembryoplastic Neuroepithelial Tumors in Children

Teda Arunrut; J. Gordon McComb, MD; Mark D. Krieger, MD (Los Angeles, CA)

11:30 – 11:39 AM

16. Long-Term Results of Interstitial Radiosurgery in Chiasmal/Hypothalamic Gliomas

Peter C. Warnke, MD, FRCS (Boston, MA); Ali Savas III, MD (Ankara, Turkey); Cristoph Ostertag, MD (Freiburg, Germany)

11:40 – 11:49 AM

17. Findings on MRI Brain Used to Triage Pre-Operative Imaging of Neuraxis in Children with Cerebellar Neoplasms

Jonathan A. Forbes; Matthew Pearson, MD (Nashville, TN)

11:50 – 11:59 AM

18. All Diffuse Intrinsic Pontine Gliomas Should be Biopsied

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

12:00 – 1:00 PM

Lunch in the Exhibit Hall

Gloucester Room

12:00 – 1:00 PM

SONS Meeting

Suffolk Room

1:00 – 2:30 PM

Session III: Developmental Anomalies

Moderators: Mark S. Dias, MD; Bermans J. Iskander, MD

1:00 – 1:09 PM

19. Influence of Dural Opening on Scoliosis in Patients with Chiari I Malformations

Todd C. Hankinson, MD (Birmingham, AL); Jason Wade; Saadi Ghatan, MD; Richard C.E. Anderson, MD; Neil A. Feldstein, MD (New York, NY)

1:10 – 1:19 PM

20. Initial Surgical Technique for the Treatment of Middle Fossa Arachnoid Cysts: Bi-Institutional Comparison of Results and Complications

Todd C. Hankinson, MD (Birmingham, NY); R. Shane Tubbs, PhD, PA-C (Birmingham, AL); Ivan Kotchetkov, BA; Richard C.E. Anderson, MD (New York, NY); Jeffrey Blount, MD; W. Jerry Oakes, MD (Birmingham, AL); Neil A. Feldstein, MD (New York, NY); John C. Wellons, MD (Birmingham, AL)

1:20 – 1:29 PM

21. Limited Access Craniosynostosis Surgery without Using Cranial Orthotics

Dean A. Hertzler, II, MD; Kerry Crone, MD; Todd Maugans, MD (Cincinnati, OH)

1:30 – 1:39 PM

22. Endoscopic Transphenoidal Fenestration of Rathke Cleft Cysts in Children

Erin Kiehna, MD; Spencer C. Payne, MD (Charlottesville, VA); Edward R. Laws Jr., MD (Boston, MA); John A. Jane Jr., MD (Charlottesville, VA)

1:40 – 1:49 PM

23. Natural History of Intracranial Arachnoid Cysts in Children

Andrew Y. Yew, BS; Wajid N. Al-Holou, MD; Zackary Boomsaad, MD; Hugh J L Garton, MD, MHSc; Karin M. Muraszko, MD; Cormac O. Maher, MD (Ann Arbor, MI)

1:50 – 1:59 PM

24. Surgical Management for Cranial Congenital Dermal Sinus

Chiachien J. Wang, PhD; Tien T. Nguyen, MD; Mark D. Krieger, MD; J. Gordon McComb, MD (Los Angeles, CA)

2:00 – 2:09 PM

25. Treatment Practices for Chiari I Malformation with Syringomyelia

Brandon Rocque, MD (Madison, WI); Timothy George, MD, FACS (Austin, TX); John Kestle, MD (Salt Lake City, UT); Bermans J. Iskander, MD (Madison, WI)

2:10 – 2:19 PM

26. Incidence of Tethered Spinal Cord in Infants with VACTERL

Brent Oneill, MD (Seattle, WA); Elizabeth Tyler-Kaberra, MD, PhD; (Pittsburgh, PA)

PROGRAM SCHEDULE

2:20 – 2:29 PM

27. Symptom Response Patterns and Role of Duraplasty and Scoliosis in Re-Tethering in Post-Myelomeningocele Repair Tethered Cord Syndrome

Vivek Arjun Mehta, BS; Chetan Bettegowda, MD; Violette Renard, MD; David Ibrahim, MD; Ulrich Thomale, MD; Ed Ahn, MD; George I. Jallo, MD (Baltimore, MD)

2:30 – 3:00 PM

Beverage Break in the Exhibit Hall

Gloucester Room

3:00 – 4:30 PM

Session IV: Functional

Moderators: Shenandoah Robinson, MD; David Frim, MD, FACS

3:00 – 3:09 PM

28. Complete vs. Anterior 2/3rd Corpus Callosotomy in Children: Analysis of Outcome

Laleh Jalilian, MD (St Louis, MO); Alexander K. Powers, MD (Wake Forest University, NC); James Johnston, MD; David D. Limbrick, MD, PhD; Matthew D. Smyth, MD, FACS (St Louis, MO)

3:10 – 3:19 PM

29. Functional Mapping in Epileptic Patients with Varying Motor Control Using Spectral Changes in ECoG

Andrew S. Geneslaw, BS; Eun-Hyoung Park, PhD; Sheryl Manganaro, BS; Joseph Madsen, MD (Boston, MA)

3:20 – 3:29 PM

30. Spinal Deformities Post Selective Dorsal Rhizotomy after the Pubertal Growth Spurt

Rajeet S. Saluja, MD; Jeff D. Golan, MD, FRCS(C); Michele Parolin, MD; Jeffery A. Hall, MD, FRCS(C); Gus O'Gorman, MD, FRCS(C); Chantal Poulin, MD, FRCS(C); Thierry E. Benaroch, MD, FRCS(C); Marie-Andree Cantin, MD, FRCS(C); Jean-Pierre Farmer, MD, FRCS(C) (Montreal, Canada)

3:30 – 3:39 PM

31. Safety of Staged Epilepsy Surgery

David Harter, MD; Jonathan Roth, MD; Chad Carlson, MD; Orrin Devinsky, MD; Howard L. Weiner, MD (New York, NY)

3:40 – 3:49 PM

32. MEG Passive Language Localization in Sedated Children

Frederick A. Boop, MD; Mark McManis, PhD; Freedom Perkins, MD; Mark Van Poppel, MD; Amy McGregor, MD; Dave Clarke, MD; James Wheless, MD (LeBonheur Children's Hospital, Memphis, TN)

3:50 – 3:59 PM

33. Corpus Callosotomy Outcomes: The Denver Children's Experience

Elisa J. Kucia, MD; Susan Koh, MD; Paul M. Levisohn, MD; Kelly Knupp, MD; Pramote Laoprasert, MD; Michael Handler, MD (Denver, CO)

4:00 – 4:09 PM

34. Seizure Localization in Pediatric Patients Using Spectral Clustering of Infra-Slow Oscillations in Gamma Band Power

Andrew L. Ko, MD; Jeffrey Ojemann, MD; Samuel Browd, MD, PhD; Edward Novotny, MD (Seattle, WA)

4:10 – 4:19 PM

35. Histological Evidence for the Significance of the Intraoperative Monitoring in Selective Dorsal Rhizotomy

Tomohisa Shimizu, MD; Toru Fukuhara, MD, PhD; Yoichiro Namba, MD (Okayama, Japan)

4:20 – 4:29 PM

36. Clinical Outcomes and Functional Recovery Following Supplementary Motor Area Resection in Pediatric Non-lesional Epilepsy Surgery

Charles B. Stevenson, MD; James Leach, MD; Joo-Hee Seo, MD; Ki Lee, MD; Katherine Holland, MD, PhD; Anna Byars, PhD (Cincinnati, OH); Matthew Smyth, MD (St. Louis, MO); Francesco Mangano, DO (Cincinnati, OH)

4:30 – 5:30 PM

Wine and Cheese in the Exhibit Hall

Gloucester Room

5:30 – 6:30 PM

Question Writing Session for SANS and ABPNS

Clarendon Room

THURSDAY, DECEMBER 3, 2009

6:45 – 7:45 AM

Meet the Leadership: Breakfast for Residents, Fellows and Medical Students

Regis Room

7:00 AM – 4:00 PM

Registration

Registration B, 4th Floor

7:00 – 8:00 AM

Continental Breakfast

Gloucester Room

7:00 AM – 4:00 PM

Speaker Ready Room

Yarmouth Room

8:00 – 8:30 AM

The Management of the Incidentally Discovered Middle Cranial Fossa Arachnoid Cyst

Sarah J. Gaskill, MD, FACS

Nalin Gupta, MD, PhD

Moderator: Cory Raffel, MD, PhD

PROGRAM SCHEDULE

8:30 – 10:00 AM

Session V: Trauma

Moderators: Corey Raffel, MD, PhD; Thomas M. Moriarty, MD, PhD

8:30 – 8:39 AM

37. Decompressive Craniectomy for Trauma in Children: Is it Worth it? A Critical Look at 75 Patients

Christina Notarianni, MD; Stephanie Einhaus, MD; Frederick Boop, MD; Robert Sanford, MD; Shelly Timmons, MD, PhD; Daniel Kueter, MD; Michael Muhlbauer, MD (Memphis, TN)

8:40 – 8:49 AM

38. Concussions in Pediatric Patients: Preliminary Results Using Diffusion Tensor Imaging, Functional MRI and Neuropsychological Testing

Rajeet S. Saluja, MD; Jen-Kai Chen, PhD; Rosanne Aleong, PhD; Gabriel Leonard, PhD; Sierra Debenham; Tomas Paus, PhD (Montreal, Canada); Michelle Keightley, PhD (Toronto, Canada); Isabelle Gagnon, PhD; Alain Ptito, PhD (Montreal, Canada)

8:50 – 8:59 AM

39. Cervical Spine Clearance in the Pediatric Trauma Population

Praful Maste, MD; Paul Porensky, MD; Promod Pillai, MD; Corey Raffel, MD, PhD; Ronald T. Grondin, MD, FRCS(C) (Columbus, OH)

9:00 – 9:09 AM

40. High Folate Diet in the Rat Significantly Increases Neural Regeneration after Spinal Cord Injury

Nirav J. Patel, MD; Nithya Hariharan, MD; Solomon Ondoma, MD; Bermans Iskandar, MD (Madison, WI)

9:10 – 9:19 AM

41. Prognosis for Children in Cardiac Arrest Shortly After Blunt Cranial Trauma

Lars Widdel, MD (Aurora, CO); Kathryn Beauchamp, MD (Denver, CO); Ken R. Winston, MD (Aurora, CO)

9:20 – 9:29 AM

42. Retroclival Epidural Hematoma: Clinical Characteristics and Diagnostic Technique

Todd C. Hankinson, MD; R. Shane Tubbs, PhD, PA-C; Christoph Griessenauer, MD; Curtis Rozzelle, MD; John C. Wellons, MD; Jeffrey Blount, MD (Birmingham, AL); Aaron A. Cohen-Gadol, MD, MSc (Indianapolis, IN); W. Jerry Oakes, MD (Birmingham, AL)

9:30 – 9:39 AM

43. Cell Proliferation and Neuronal Migration after Closed Head Injury in the Immature Piglet

Symeon Missios, MD; Brent Harris, MD, PhD; Michael Simoni, BS; Tarek Radwan, MD; Beth Costine, PhD; Carter Dodge, MD; Simon Hillier, MD; Leslie B. Adams; Ijeoma S. Chinwuba; Kate Hillier; Ann-Christine Duhaime, MD (Lebanon, NH)

9:40 – 9:49 AM

44. Wartime Pediatric Neurosurgery: The Experience in Afghanistan during Operation Enduring Freedom

Paul Klimo, MD, MPH (WPAFB, OH); Brian Ragel, MD (Portland, OR); William Scott, DO (Las Vegas, NV)

9:50 – 9:59 AM

45. Serial Radiography in Abusive Head Trauma: A Penn State Update

Mark S. Dias, MD; Ray K. Bradford, BS; Arabinda Choudhary, MD (Hershey, PA)

10:00 – 10:10 AM

Franc D. Ingraham Distinguished Service Award: David G. McLone, MD, PhD

10:10 – 10:40 AM

Beverage Break in the Exhibit Hall Reception for David G. McLone, MD, PhD

10:40 AM – 12:00 PM

Session VI: Tumors/Developmental Anomalies

Moderators: Ian F. Pollack, MD; Thomas Pittman, MD

10:40 – 10:49 AM

46. The Human and Rat Filum Terminale: A Novel Source of Multipotent Cells

Ruchira M. Jha, MD; Joseph Madsen, MD; Ryan Chrenek, BA; Xiaojin Liu, PhD; David L. Cardozo, PhD (Boston, MA)

10:50 – 10:59 AM

47. Atlantal Hemi-Rings and Cranial-Cervical Instability: Identification, Clinical Characteristics, and Management

Taryn M. Bragg, MD, MS; Douglas L. Brockmeyer, MD (Salt Lake City, UT)

11:00 – 11:09 AM

48. Positional Plagiocephaly Management at the Children's Hospital of Eastern Ontario- Long Term Outcomes

Michael Vassilyadi, MD, FRCS(C); Mohammed F. Shamji, MD, PhD; Praneal Merchant, BSc; Elana C. Fric-Shamji, MD; Karen Dube, RN, NP; Enrique C.G. Ventureyra, MD, FRCS(C) (Ottawa, Canada)

11:10 – 11:19 AM

49. A Method for Early Correction of Anterior Calvarial Craniosynostosis Using Minimally Invasive Orbital Advancement

Ian M. Heger, MD (Jacksonville, FL); Eric Stelnicki, MD; Ari-Yuri Camargo (Hollywood, FL)

11:20 – 11:29 AM

50. Successful Resection of Cystic Hygromas of the Neck Involving the Brachial Plexus

Daniel Harmon, MD; Todd C. Hankinson, MD; Nadine Bradley, BSN, RN; Chevis Shannon, MBA; R. Shane Tubbs, PhD, PA-C; John C. Wellons, MD (Birmingham, AL)

PROGRAM SCHEDULE

11:30 – 11:39 AM

51. Maternal Embryonic Leucine Zipper Kinase is an Enrichment Marker for Tumor-Initiating Cells in Medulloblastomas and Plays a Key Role in Their Proliferation

Lissa C. Baird, MD; Amber Miller, MS; Hal S. Meltzer, MD; Michael L. Levy, MD, PhD; Alexey Terskikh, PhD (San Diego, CA)

11:40 – 11:49 AM

52. The Human Neonatal Cerebrospinal Fluid Proteome: Application of Nano-LC-FT-MS Proteomics to Post-Hemorrhagic Hydrocephalus

David D. Limbrick, MD, PhD; Carrie Mercier, BS; Reid Townsend, MD, PhD; Terrie Inder, MD, PhD (St. Louis, MO)

11:50 – 11:59 AM

53. The Role of a Gluteal Crease Abnormality in Predicting an Underlying Tethered Cord in Children

Kurtis I. Auguste, MD (San Francisco, CA); Sue Ditmyer, NP; Peter P. Sun, MD (Oakland, CA)

12:00 – 1:00 PM

Lunch in the Exhibit Hall

Gloucester Room

12:00 – 1:00 PM

Hydrocephalus Association Meeting

Suffolk Room



1:00 – 2:30 PM

Raimondi Lecture

Charles Stiles, PhD

Transcription Factors and Malignant Glioma in Mouse and Man

2:30 – 3:00 PM

Beverage Break in the Exhibit Hall

Gloucester Room

3:00 – 5:00 PM

Session VII: Hydrocephalus II

Moderators: Bruce A. Kaufman, MD, FACS; Howard J. Silberstein, MD

3:00 – 3:09 PM

54. The Terminal Myelocystocele

Christopher Gegg, MD; Greg Olavarria, MD; Keyne Johnson, MD; Jogi Pattisapu, MD (Orlando, FL)

3:10 – 3:19 PM

55. Bipolar Versus Monopolar Coagulation of Occluding Tissue in Ventriculoperitoneal Shunts

Mustafa Q. Hameed, MD; Tomer Anor, PhD; Joseph R. Madsen, MD (Boston, MA)

3:20 – 3:29 PM

56. Predictors of Ventricular Shunt Infections in Children

Elisabeth Ashley, MD; Joseph R. Madsen, MD; Amir Kimia, MD; Lise E. Nigrovic, MD, MPH; Mark I. Neuman, MD, MPH (Boston, MA)

3:30 – 3:39 PM

57. VEGF-Induced Ventriculomegaly and Neutralizing Angiogenesis

Joon W. Shim, PhD; Johanna Sandlund, MD, PhD; Carin H. Han; Mustafa Q. Hameed, MD; Michael Klagsbrun, PhD; Joseph R. Madsen, MD (Boston, MA)

3:40 – 3:49 PM

58. Comparison of Ventricular Reservoirs and Ventriculosubgaleal Shunts in the Management of Post-Hemorrhagic Hydrocephalus

James M. Johnston, MD; Matthew D. Smyth, MD; James Sagar, MD; Tae Sung S. Park, MD; Jeffrey R. Leonard, MD; Rebecca Munro, MA; David Limbrick, MD, PhD (St. Louis, MO)

3:50 – 3:59 PM

59. Shunt Survival Following Surgical Release of Tethered Spinal Cord

David M. Ibrahim, MD; Vivek A. Mehta, BS; Benjamin S. Carson, MD; George I. Jallo, MD; Edward S. Ahn, MD (Baltimore, MD)

4:00 – 4:09 PM

60. Fourth Ventricular Shunt Survival Comparing Stereotactic Transtentorial and Suboccipital Approaches

Frank S. Bishop, MD; Mandy J. Binning, MD (Salt Lake City, UT); Nicholas M. Wetjen, MD (Rochester, MN); Daniel E. Couture, MD (Winston Salem, NC); Douglas L. Brockmeyer, MD (Salt Lake City, UT)

4:10 – 4:19 PM

61. Intraoperative Assessment of Cerebral Aqueduct Patency and Cisternal Scarring: Impact on Success of Endoscopic Third Ventriculostomy in 403 African Children

Benjamin C. Warf, MD (Boston, MA); Abhaya V. Kulkarni, MD, PhD (Toronto, Canada)

4:20 – 4:29 PM

62. Ventriculo-Subgaleal Shunting: A Strategy to Reduce the Incidence of Slit Ventricles and Shunt Revisions

Anthony L. Petraglia, MD; Vassilios G. Dimopoulos, MD; Howard J. Silberstein, MD, FACS (Rochester, NY)

4:30 – 4:39 PM

63. Quality of Life in Obstructive Hydrocephalus: Endoscopic Third Ventriculostomy Compared to Cerebrospinal Fluid Shunt

Abhaya V. Kulkarni, MD, PhD; Sonya Hui, BSC; Iffat Shams, MSc; Ruth Donnelly, PhD (Toronto, Canada)

4:40 – 4:49 PM

64. DTI Findings in Children with Benign External Hydrocephalus

Dean A. Hertzler, II, MD; Weihong Yuan, PhD; Blaise V. Jones, MD; Akila Rajagopal, MS; Alessandro Cancelliere, PhD; Charles B. Stevenson, MD; Francesco T. Mangano, DO (Cincinnati, OH)

4:50 – 4:59 PM

65. Re-Infection Following Initial Cerebrospinal Fluid (CSF) Shunt Infection

Tamara D. Simon, MD, MPH (Salt Lake City, UT); Matthew Hall, PhD (Child Health Corporation, Shawnee Mission, KS); J. Michael Dean, MD, MBA; John R.W. Kestle, MD, MSc; Jay Riva-Cambrin, MD, MSc (University of Utah, Salt Lake City, UT)

5:00 – 5:30 PM

Business Meeting

Salon E

FRIDAY, DECEMBER 4, 2009

7:00 AM – 3:00 PM

Registration

Registration B, 4th Floor

7:00 – 8:00 AM

Continental Breakfast

Gloucester Room

7:00 AM – 4:00 PM

Speaker Ready Room

Yarmouth Room

8:00 – 8:30 AM

The Management of Incidentally Discovered Chiari I Malformation

Richard G. Ellenbogen, MD, FACS; David M. Frim, MD, FACS
Moderator: James M. Drake, MD

8:30 – 10:00 AM

Session VIII: Technical/Vascular

Moderators: James M. Drake, MD; Cormac O. Maher, MD

8:30 – 8:39 AM

66. Transnasal Odontoidectomy Followed by Posterior Decompression and Occipitocervical Fusion in Children with Chiari I Malformation and Ventral Brainstem Compression

Richard C. Anderson, MD; Todd C. Hankinson, MD; Eli Grunstein, MD (New York, NY); Paul Gardner, MD; TJ Spinks, MD (Pittsburg, PA)

8:40 – 8:49 AM

67. Pus and Free Bone Flaps

Lars Widdel, MD; Ken Winston, MD (Aurora, CO)

8:50 – 8:59 AM

68. Preoperative Motor Mapping with Resting State Functional Connectivity Magnetic Resonance Imaging

James M. Johnston, MD; Carolyn E. Pizoli, MD, PhD; Joshua Shimony, MD, PhD; David D. Limbrick, MD, PhD; Matthew D. Smyth, MD (St. Louis, MO)

9:00 – 9:09 AM

69. The Efficacy and Safety of Occipital Screw Placement for Occipitocervical Fusion in Children

Joshua J. Chern, MD, PhD; Katherine Relyea, MS; Daniel J. Curry, MD; William E. Whitehead, MD, MPH; Thomas G. Luerssen, MD; Andrew Jea, MD (Houston, TX)

9:10 – 9:19 AM

70. Minimally Invasive Placement of Pedicle Screws in Adolescent Patients Using a Neuronavigation Platform

Gregory Heuer, MD; Eamon McLaughlin, BS; Joel A. Bauman, MD; Phillip B. Storm, MD (Philadelphia, PA)

9:20 – 9:29 AM

71. Use of Suboccipital Autograft in Pediatric Cervical Spine Fusion

Douglas A. Hardesty, BA; Joel A. Bauman, MD; Gregory G. Heuer, MD, PhD; Phillip B. Storm, MD (Philadelphia, PA)

9:30 – 9:39 AM

72. Intraoperative Monitoring of Motor-Evoked Potentials in Very Young Children Less Than 3 Years of Age

Andrew H. Jea, MD; Krishna B. Satyan, MD; Lillian M. Wilder; James J. Riviello, MD; Stephen A. Stayer, MD; William E. Whitehead, MD; Daniel J. Curry, MD; Robert C. Dauser, MD; Thomas G. Luerssen, MD (Houston, TX)

9:40 – 9:49 AM

73. Intracranial Hemorrhage and Neurosurgical Intervention during Extracorporeal Membrane Oxygenation

Shawn L. Hervey-Jumper, MD; Andrea Yancon, BS; Gail Annich, MD, MS; Hugh J L Garton, MD, MHSc; Karin M. Muraszko, MD; Cormac O. Maher, MD (Ann Arbor, MI)

9:50 – 9:59 AM

74. Pial Synangiosis in Patients with Moyamoya Under Two Years Old

Eric M. Jackson, MD; R. Michael Scott, MD; Edward R. Smith, MD (Boston, MA)

10:00 – 10:30 AM

Beverage Break in the Exhibit Hall

Gloucester Room

10:30 AM – 12:00 PM

Session IX: Case Reports/Hydrocephalus

Moderators: Peter P. Sun, MD; Mark D. Krieger, MD

10:30 – 10:39 AM

75. Sacroiliac Joint Pain in Pediatric Patients

Jeffrey Leonard, MD (St Louis, MO); Rebecca Munro, MA; Alex Powers, MD (Winston-Salem, NC); Joan Puglisi, PT (St. Louis, MO)

10:40 – 10:49 AM

76. Disruption of Essential Neurodevelopmental Cytokine Networks is Exacerbated by Combined Prenatal Inflammatory and Hypoxic-Ischemic Injury

Shenandoah Robinson, MD; Obehi Irumudomon, BA; Qing Li, MD (Cleveland, OH)

10:50 – 10:59 AM

77. Survival of Adjustable Valve Shunts and Set-Pressure Valve Shunts in Children with Hydrocephalus

Krzysztof R. Drzymalski, BA; Meshkan Moghimi, BA; Nikki Thuijs, BA; Joseph Madsen, MD (Boston, MA)

11:00 – 11:09 AM

78. Immortalization and Functional Characterization of Rat Arachnoid Cells

Christopher Janson, MD (Minneapolis, MN)

11:10 – 11:19 AM

79. Lysis of Abdominal Adhesions for Distal Catheter Placement in the Difficult to Shunt Patient

Daniel K. Harmon, MD; Chevis Shannon; Reed Gavin; Shane Tubbs, PhD; Curtis Rozzelle, MD; Jeffery Blount, MD; W. Jerry Oakes, MD; Jay Wellons, MD (Birmingham, AL)

11:20 – 11:29 AM

80. A Novel Method for Cerebrospinal Fluid Diversion Utilizing the Sternum: A Cadaveric and Animal Study

David F. Bauer, MD; R. Shane Tubbs, PhD, PA-C; M. Rene Chambers, MD (Birmingham, AL); Marios Loukas, MD, PhD (Grenada, St. George's University); Mohammadali M. Shoja, MD; Aaron A. Cohen-Gadol, MD, MSc (Indianapolis, IN)

11:30 – 11:39 AM

81. Meningioangiomas: Clinical, Pathological and Radiographic Review of Six Cases

Susan C. Williams, MD; David Zagzag, MD; Werner Doyle, MD; Jeffrey Wisoff, MD (New York, NY)

11:40 – 11:49 AM

82. Infant Arachnoid Cysts have a Different Natural History than Arachnoid Cysts in Later Childhood

Ashutosh Singhal, MD; Daria Krivosheya, MD; D. Douglas Cochrane, MD; Paul Steinbok, MD (Vancouver, Canada)

11:50 – 11:59 AM

83. HASTE MRI in Children with Hydrocephalus

Brent Oneill, MD; Ryan Robison; Kieko Weir; Harman Bains; Sumit Pruthi, MD; Samuel Browd, MD, PhD (Seattle, WA)

12:00 – 12:10 PM

Closing Remarks

Liliana Goumnerova, MD, FRCS(C)
Ann-Christine Duhaime, MD

12:15 – 1:00 PM

Lunch for those attending Neurofibromatosis Symposium

Clarendon Room

1:00 – 4:00 PM

Neurofibromatosis Symposium

Salon E

1:00 – 1:30 PM

Genetics/Diagnosis

Nicole Ullrich, MD, PHD

1:30 – 2:00 PM

Radiology

Tina Young-Poussaint, MD

2:00 – 2:15 PM

Coffee break

Salon E Foyer

2:15 – 2:45 PM

Spine considerations

John Emans, MD

2:45 – 3:30 PM

Surgery and Its Role in the Management of Patients with NF1

R. Michael Scott, MD

3:30 – 4:00 PM

Outcome and Adjuvant Therapy in NF1

Mark Kieran, MD, PhD



SPEAKER DISCLOSURE INFORMATION

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ORAL ABSTRACTS

1. Variations among Experienced Pediatric Neurosurgeons in Treating Hydrocephalus

A. Leland Albright, MD (Madison, WI)

Introduction: Randomized, controlled studies have shown that programmable shunts are no better than non-programmable shunts, and that endoscopic shunt insertion is no better than free-hand insertion. The present study was conducted to determine if there was consensus among extremely experienced pediatric neurosurgeons about day-to-day questions of hydrocephalus management.

Methods: Six pediatric neurosurgeons and the author were asked 1) What shunt do you use most frequently; 2) Do you routinely use any adjunct in catheter insertion? 3) Do you insert shunts frontally or posteriorly; 4) How frequently do you follow shunted patients after infancy; 5) Do you get yearly scans in follow-up; 6) Do you revise shunts in asymptomatic children with ventricular enlargement; and 7) How do you prevent slit-ventricle syndrome.

Results: 1) 4/7 use differential pressure valves; none use programmable valves routinely. 2) 4/7 use adjuncts (ultrasound or pen endoscope) to guide catheter insertion. 3) 4/7 insert shunts frontally. 4) Patients follow-up intervals range from 6 months to 5 years. 5) No one obtains yearly followup scans. 6) Most observe asymptomatic ventriculomegaly although revisions were more likely in spina bifida patients. 7) There was no consensus on preventing slit-ventricles; judicious shunting and OSV were mentioned.

Conclusions: Extremely experienced pediatric neurosurgeons manage hydrocephalic patients very differently. It seems probable that individual outcome data re long-term shunt function, catheter tip location, frequency of slit-ventricle syndrome, etc., are unknown.

2. The Association between Cerebrospinal Fluid Shunting and Hearing Loss in Children with Medulloblastoma

Daniel J. Guillaume, MD, MS; Kristin Knight, MS; Edward Neuwelt, MD (Portland, OR)

Introduction: Cerebrospinal fluid (CSF) shunting is associated with measurable hearing loss in some cases. The etiology is unclear, but it is hypothesized that CSF pressure changes affect cochlear physiology in certain patients. Radiation and cisplatin chemotherapy increase risk for hearing loss. We hypothesized that hearing loss would be greater in shunted compared to un-shunted children with medulloblastoma undergoing radiation and chemotherapy.

Methods: Baseline and longitudinal audiologic data was collected on 35 consecutive patients who received radiation and cisplatin chemotherapy. Additional collected data included age, gender, date shunted, dates of chemotherapy and radiation; shunt complications, and administration of other ototoxic medications. Hearing sensitivity and peripheral auditory function measures included pure tone, conditioned play, and immittance audiometry; and distortion product evoked otoacoustic emissions. Hearing loss severity was determined using Brock hearing loss grades. Association of hearing loss, according to the American Speech Language Hearing Association criteria, and shunting was determined.

Results: Of 35 patients with medulloblastoma evaluated, 14 (40%) were shunted. Significant hearing loss occurred in 13/21 (62%) of patients without shunts, and in 14/14 (100%) of patients with shunts. The difference between rates of hearing loss in shunted versus un-shunted patients was significant with a p-value of 0.013 using a two-tailed Fisher's exact test.

Conclusion: This study suggests there is an association between CSF shunting and hearing loss in children treated with radiation and chemotherapy. This lays the foundation for a prospective study evaluating the incidence of hearing loss in children with shunts who are not being treated with ototoxic therapy.

3. The Dynamics of Brain and CSF Growth in the Developing Hydrocephalic Mouse

Jason G. Mandell, MS; Thomas Neuberger, PhD; Corina S. Drapaca, PhD; Andrew G. Webb, PhD; Steven J. Schiff, MD, PhD (University Park, PA)

Introduction: Traditionally, hydrocephalus has been clinically quantified by ventricular size, with adjunct use of cortical mantle thickness. Nevertheless, clinical outcome is related to brain cognitive function, which is more directly related to brain volume than to traditional measures. We are unaware of existing quantification of the dynamics of brain and CSF volume growth in normal versus hydrocephalic development.

Methods: Hydrocephalus was induced in 14-day-old C57BL/6 mice by percutaneous injection of kaolin into the cisterna magna. Hydrocephalic (n=6) and normal (n=6) mice were serially imaged from 2-12 weeks of age with 14.1 tesla MRI. Total brain and ventricle volumes were segmented, and linear discriminant analysis (LDA) used to classify the results.

Results: Two very different patterns of response were seen in hydrocephalic mice compared with normative growth curve data. In one pattern (n=2), brain growth was normal despite the accumulation of CSF and head enlargement, and in the second pattern (n=4), brain volume growth was faster than normal as CSF volume increased with parenchymal edema. In this latter pattern, spontaneous rupture of the ventricular system led to a normalization of brain volume, implying edema from transmantle pressure gradients. These hydrocephalic patterns were significantly different using LDA (Wilks' lambda=0.1599, p< 0.01 by Chi-Squared distribution).

Conclusions: This study is, to our knowledge, the first serial quantification of brain and ventricle volumes in normal versus hydrocephalic development. Our findings suggest that neonatal hydrocephalus can have very different patterns of volume growth, almost impossible to observe with traditional clinical measures, and that automated volumetric methods will be of clinical value.

4. Vascular Endothelial Growth Factor as a Potential Target for Hydrocephalus

Joseph R. Madsen, MD; Joon W. Shim, PhD; Johanna Sandlund, MD, PhD; Mustafa Q. Hameed, MD; Susan Connors, BS; Sandra Smith, MS; Laurel Fleming, BA; Gani Abazi, MD, MPH; Michael Klagsbrun, PhD (Boston, MA)

Introduction: Hydrocephalus is the most common problem treated by the pediatric neurosurgeon. Recently, it has been proposed that abnormalities in intracranial pulsatile dynamics might be more important, and that there might be a link between hyperpulsatility and vascular permeability. Here we explored the relationship between hydrocephalus and vascular endothelial growth factor A (VEGF-A), also known as vascular permeability factor.

Methods: We assayed VEGF-A in CSF gathered from pediatric patients undergoing intradural surgery for nonneoplastic conditions, including hydrocephalus. CSF samples were quantitatively analyzed by ELISA (enzyme-linked immunosorbent-assay), sensitive to two human isoforms, VEGF-A121 and VEGF-A165.

Results: VEGF-A165 and VEGF-A121 concentrations in the CSF from patients with hydrocephalus were significantly higher (p <0.0001) compared with CSF from control patients. Also, CSF VEGF-A165/121 level in four different age groups of hydrocephalic patients was examined. Although CSF from neonates does not exist within non-hydrocephalic groups, VEGF-A level differs amongst all patient population when divided into four age groups (p=0.00001). The second (~18 mo.) and third age (~16 yr.) group

showed elevated levels of CSF VEGF-A compared to controls ($p < 0.05$). Further on, VEGF-A165/121 levels in patients with posthemorrhagic hydrocephalus (median 120 pg/mL) were significantly elevated ($p = 0.021$) compared with nonhemorrhagic hydrocephalus (median 29.5 pg/mL).

Conclusions: This clinical study suggests that VEGF-A may plausibly play a role in the pathophysiology of hydrocephalus. The success of anti-VEGF treatments in very low dose for edema associated with macular degeneration and diabetic retinopathy suggests that anti-VEGF treatment in hydrocephalus could in some cases be a therapeutic target.

5. Effectiveness of a Clinical Pathway for Patients with Cerebrospinal Fluid Shunt

Joshua J. Chern, MD, PhD; Charles G. Macias, MD, MPH; Andrew Jea, MD; Daniel J. Curry, MD; Thomas G. Luerksen, MD; William E. Whitehead, MD, MPH (Houston, TX)

Introduction: Patients with CSF shunts often present to the emergency department (ED) with suspected shunt malfunction. A protocol was implemented at a tertiary children's hospital ED to expedite the care of these patients.

Methods: The protocol assigned all patients with CSF shunt into three pathways. If a patient presented with altered mental status, or acute focal neurological deficit, or ongoing seizure activity, an ED physician was immediately notified (emergent pathway). If a patient presented with emesis, or headache, or increasing frequency of seizure, or parental concern for shunt malfunction, the patient entered the expedited pathway, and imaging studies were ordered prior to physician evaluation. All other patients entered the default pathway, in which a physician would evaluate the patient before deciding on further workup. Outcomes of interest included measures of timeliness in the ED and clinical outcomes.

Results: The total time to complete both ED physician evaluation and to initiate imaging studies was significantly shorter in the protocol period than in the pre-protocol period (104 vs. 147 min.). Similar time saving over the two processes was demonstrated comparing expedited and default pathways during the protocol period (95 vs. 134 min.). Clinically, more patients underwent surgery in the expedited pathway than the default pathway (36% vs. 17%), and patients in the expedited pathway had a shorter hospital stay (3.35 ± 0.9 days vs. 5.66 ± 4.04 days, $p = 0.02$).

Conclusions: An ED-based protocol helped identify patients at risk for shunt failure early in the triage process and shortened the assessment process prior to neurosurgical intervention.

6. Endoscopic Third Ventriculostomy for Shunt Malfunction: What to do with the Shunt

Julian J. Lin, MD; David Neils, MD (Peoria, IL)

Introduction: ETV is an effective surgical option for the treatment of shunt malfunction. The role of post-operative CSF diversion is not clearly understood at this time. We compare the effects of shunt-removal/ligation, shunt externalization/EVD placement, and no treatment of shunt at the time of ETV.

Methods: We retrospectively reviewed the records of 20 consecutive patients treated at our institution for shunt malfunction with ETV. Patient data were retrospectively evaluated for the effect that the fate of the shunt plays on ETV success rates.

Results: In our series of 20 patients we had an overall success rate of 72% with using ETV for shunt malfunction. Patients who had their shunts ligated at the time of surgery had a success rate of 87%, in comparison to those whom the shunt was left untouched who had a success rate of 70%, or patients who had a perioperative external ventricular drain (EVD) for whom the success rate was 50%.

Conclusions: This series of ETV for shunt malfunction performed at a single center by a single surgeon shows a success rate similar to the published literature range of 67 to 80 percent success whether the shunt is ligated or left undisturbed. It is not necessary to ligate the in situ shunt at the time of ETV, however; there may be a trend towards an improved success rate with shunt ligation. Further studies with a greater numbers of patients are warranted.

7. The Effect of MRI's on Programmable Shunts: A Retrospective Study

Keyne K. Johnson, MD; Valleria Bagley, MD; Jogi Pattisapu, MD; Christopher Gegg, MD; Greg Olavarria, MD (Orlando, FL)

Introduction: With the advent of the flash brain MRI to reduce the amount of radiation exposure our practice has utilized this modality to evaluate our shunted hydrocephalus patients. At the same time we have also began to implant more programmable valves than in the past. The caveat being that these valves frequently require reprogramming after MRI exposure. To our knowledge no one has looked at the effects of multiple readjustments on the longevity of these valves.

Methods: We retrospectively reviewed fifty four patients who underwent proximal shunts revisions from 1998 to 2007. We excluded patients with tumors, revisions due to infections, and patients undergoing revisions distal to the valve. We compared patients with non-programmable valves to those patients with programmable valves and analyzed the number of MRIs and the number of months before revision. There were eighteen (18) patients in the non-programmable group and thirty-six (36) patients in the programmable group with the average age being 13.2 years and 10.3 years respectively.

Results: The average number of MRIs in the nonprogrammable group was less than that in the programmable group, 2.7 vs. 3.5 respectively. The average months before revision were significantly higher in the nonprogrammable group as compared to the programmable group, 25.3 vs. 11.7. Given the small sample size we were unable to test for statistical significance.

Conclusion: This study indicates that there is a correlation between the number of MRIs and the number of months before revision of programmable. This may suggest that multiple readjustments of these valves may contribute to their malfunction.

ORAL ABSTRACTS

8. Shunting in Chronic Hydrocephalus Induces VEGFR-2 and Blood Vessel Density Changes in the Hippocampus

Mark Luciano, MD, PhD; Abhishek Deshpande, BS; Stephen Dombrowski, PhD; Natalie Krajcir, BA; Nicholas Zingales; Jun Yang, MD (Cleveland, OH)

Introduction: Hydrocephalus has been associated with decreased cerebral blood flow and oxygen delivery. We have previously observed a decreased cerebral blood flow in CH which was associated with a stimulation of Vascular Endothelial Growth Factor Receptor -2 (VEGFR-2) expression and a late increased in vascular density. In this study we investigated the effect of shunting hydrocephalic animals on neuronal VEGFR-2 expression and blood vessel densities (BVD) in the hippocampus.

Methods: A total of fourteen (n=14) canines were divided into three groups. CH-Shunted animals (CH-S, shunted at 12 weeks) (n=4) were compared with CH-Untreated animals (CH-U, 12-16 weeks, n=5) and Surgical Controls (SC, 12-16 weeks, n=5). The density of blood vessels and VEGFR-2 positive neurons was estimated using stereological counting methods and expressed as a percent (%) of total neurons.

Results: Untreated hydrocephalic animals had two to four times the amount of %VEGFR-2 neurons compared to controls. Shunted animals had a significantly lower %VEGFR-2+ neuronal expression (21-32%) compared to untreated (14-26%) (p=0.01). Similarly, BVD was highest in untreated compared with controls. Except the CA1 region, there was no difference between controls and shunted.

Conclusions: In the hippocampus, CSF shunting appears to significantly reverse both the VEGFR-2 neuronal activation and the increased blood vessel density seen in CH. This is consistent with the hypothesis that hydrocephalus is associated with chronic hypoxia/ischemia which is resolved by CSF removal. Control of VEGF system activation, through agonists or antagonists, may ultimately provide a means of reducing brain dysfunction and injury.

9. Imaging Characteristics Were Not Predictive of Ventriculosubgaleal Shunt Conversion in VLBW Infants with Post-Hemorrhagic Hydrocephalus

Sam A. McBride; Amelia K. Boehme; Chevis N. Shannon, MBA; Jay Riva-Cambrin; Curtis J. Rozzelle, MD; Jeffrey P. Blount, MD; W. Jerry Oakes, MD; Waldemar A. Carlo, MD; John C. Wellons, III, MD (Birmingham, AL)

Introduction: In preparation for a multicenter prospective study to standardize the management of surgical temporization in VLBW infants with post-hemorrhagic hydrocephalus (PHH), we have examined ventriculosubgaleal (SGS) management at our institution and hypothesized a priori that the status of the abdomen for distal shunting drove conversion and not the size of ventricles or characteristics of the clot itself.

Methods: From 2001 to 2008, 40 children born less than 37 weeks gestation and less than or equal to 1500 grams diagnosed with grade 3/4 IVH initially received a SGS for hydrocephalus and were included in this study. Patients who went directly to VPS after initial SGS were compared to those who underwent SGS revision after initial SGS. Statistical significance was considered if p is less than 0.05.

Results: Birth weights, weights at initial SGS placement, and gestational ages between the two groups were similar. Imaging findings including frontal occipital ratio (FOR), clot size, and clot density were not different between groups. The status of the abdomen for distal shunting was predictive for conversion (p=0.032). OFC at second procedure (p=0.005), weight at second procedure (p=0.021), and time from first to second procedure (p=0.026) were statistically significant between groups and may be partially explained by earlier initial SGS failure that drove SGS revisio.

Conclusions: Imaging findings were not predictive in determining conversion from SGS to VPS. The suitability of the abdomen for distal shunting did. Earlier initial SGS failure may have also driven revision instead of conversion. Prospective studies are needed to discern best treatment.

10. Surgical Management of Giant Pediatric Craniopharyngiomas

Robert E. Elliott, MD; Kevin Hsieh, MD; Jeffrey H. Wisoff, MD (New York, NY)

Introduction: To assess oncological and functional outcomes of children who underwent radical resection of giant craniopharyngiomas (5 cm or greater in diameter).

Methods: Between 1986 and 2006, 26 children under the age of 18 underwent radical resection of giant craniopharyngiomas (14 males/12 females; mean age: 10.5 years). Data were retrospectively collected to assess the outcome of surgical treatment.

Results: Twenty of 26 patients (77%) underwent gross-total resection (GTR). There was no operative mortality and 18 of 26 patients (72%) are alive at a mean follow-up of 8.9 years (median: 9.3 years). Disease control was achieved in 21 patients (84%) and was more successful in patients who underwent GTR (95%) compared to subtotal resection (50%; p=0.03). Diabetes insipidus occurred in 73% of patients. New or worsened deficits in visual acuity and fields occurred in 17% and 29% of patients, respectively. Four patients (16%) experienced significant, permanent neurological deficits and 5 patients (20%) had mild to moderate deficits. New or worse hypothalamic disturbance occurred in 35% of patients and 15% developed obesity. Tumors involving increasing numbers of intracranial spaces were associated with a higher rate of tumor recurrence (p=0.02). There was no association between the number of intracranial spaces involved and permanent neurological morbidity (p=0.25), preoperative Wen functional status (p=0.2) or postoperative Wen functional outcome (p=0.48).

Conclusions: Radical resection of giant craniopharyngiomas in children can provide excellent rates of disease control but is less successful in recurrent tumors. Children with giant craniopharyngiomas may have decreased survival and higher neurological complications compared to children with smaller tumors.

11. Safety and Utility of Scheduled Non-Narcotic Analgesic Medications in Children Undergoing Craniotomy for Brain Tumor

David F. Bauer, MD; Alicia M. Waters, BS; R. Shane Tubbs, PhD, PA-C; Curtis J. Rozzelle, MD; John C. Wellons III, MD; Jeffrey P. Blount, MD; W. Jerry Oakes, MD (Birmingham, AL)

Introduction: We have reported that a scheduled NSAID regimen following dorsal lumbar rhizotomy and Chiari I malformation decompression is efficacious in managing post operative pain in children. We aimed to elucidate the safety and utility of this analgesic protocol in children following craniotomy for brain tumor.

Methods: A database review identified children who received a scheduled dose of alternating acetaminophen and ibuprofen following craniotomy for tumor biopsy or resection. Post operative imaging was evaluated for evidence of hemorrhage and patient charts were evaluated for the need for post operative narcotics for breakthrough pain.

Results: Fifty-one consecutive children were identified who met inclusion criteria. The age range was 1 to 16-years-old. Forty-six resections and five open biopsies were performed. Tumor histology was varied. On post operative imaging, nine patients (17.6%) had routine, post-operative blood in the resection cavity. One patient

had moderate post operative bleeding in the tumor cavity (1.9%). No patient was symptomatic and no patient required a return to the operating room. Twenty-eight patients required post operative morphine for breakthrough pain (54.9%), twenty-one of which received less than three doses (75.0%). Overall, forty-four of fifty-one patients (86.3%) required no or minimal narcotic medication for pain. The average length of hospital stay was 4.29 days.

Conclusions: A scheduled regimen of NSAIDS given in alternating doses immediately after craniotomy for tumor and throughout hospitalization did not result in any significant post-operative hemorrhage in our patient series. It appears that such a regimen lessens the need for postoperative narcotics.

12. Endonasal Endoscopic Assisted Transphenoidal Resection of Sellar/Suprasellar Lesions in the Pediatric Population

Shaan Raza, MD; James Frazier, MD; Kaisorn Chaichana, MD; Violette Recinos, MD; Alfredo Quinones-Hinojosa, MD; George I. Jallo, MD (Baltimore, MD)

Introduction: Sellar/suprasellar lesions are traditionally approached through transphenoidal resection, craniotomy or a combination where the anatomy dictates the approach. Anatomic considerations in the pediatric population -- smaller nostrils/ nasopharynx, and a smaller sphenoid sinus not fully pneumatized until age sixteen -- pose limitations on traditional surgical approaches. Endoscopy has provided a minimally invasive means that can be employed alone or with the microscope to resect sellar/suprasellar lesions in the pediatric population. We report our experience.

Methods: The approach is performed through one nostril with lateralization of the medial turbinate and medial mobilization of the nasal septum. Resection is through a combination of endoscope and microscope with use of angulated instruments. A lumbar drain is inserted for lesions with suprasellar extension.

Results: Eleven patients underwent thirteen resections via endonasal endoscopic-assisted transphenoidal microsurgery. Patient cohort consisted of 9 males and 4 females with a mean age of 14 (3 - 17 yrs). Ten craniopharyngiomas, two pituitary tumors and one Rathke's cleft cyst were resected. Eleven lesions had suprasellar extension while all were confined to the midline with no extension lateral to the carotid arteries. Gross total resection was obtained in seven patients while near total resection achieved in four patients. No post-operative CSF leaks occurred.

Conclusions: With anatomic considerations specific to the pediatric population taken into account, satisfactory resection was obtained in a majority of patients through endonasal endoscopic-assisted microsurgery. This approach can be performed via one nostril with the lack of turbinate/septum resection. The use of endoscopes with angulated transphenoidal instruments permits work through a narrow corridor.

13. Clinical Management and Seizure Control in Pediatric Gangliogliomas

Chiachien J. Wang, PhD; J. Gordon McComb, MD; Mark D. Krieger, MD (Los Angeles, CA)

Introduction: Gangliogliomas are rare tumors which commonly present with seizures. This study evaluates management and outcome of gangliogliomas.

Methods: Under an IRB-approved protocol, we retrospectively reviewed medical records from patients surgically treated for gangliogliomas during the past 15 years. 23 cases were identified. Factors such as age, gender, tumor location, initial presentation, pathology, and extent of resection were analyzed.

Results: Median age at operation was 10 years (3-226 months) without gender predilection. Median follow-up was 40 months. Seizures (70%), headaches (73%), and neurologic deficits (43%) were the most common signs and symptoms upon presentation. While low-grade gangliogliomas were predominantly found in the temporal region (55%), the distribution of anaplastic gangliogliomas was more variable (2 parietal and 1 occipital). 14 patients had gross total resection; of these, 4 had subsequent recurrence. 9 patients had subtotal resection; of these, 3 had no further therapy and remained free of seizures and progression. 10 required a second surgery (4/14 patients who had GTR and 6/9 with STR); of these, 2 required a third surgery, and 5 had adjuvant chemotherapy and/or radiation therapy. Median time to recurrence was significantly longer in cases which had GTR compared to STR (63 months vs 5 months, $p=0.003$). 1 patient with anaplastic ganglioglioma was treated with surgery and adjuvant therapy and survived without progression at 71 month-follow-up. 21/23 patients had no further seizures after complete surgical resection.

Conclusions: Complete resection should be the preferred treatment in pediatric gangliogliomas. Recurrent tumors can be successfully managed by surgery and adjuvant therapies.

14. Recurrence Risk Associated with Immediate and Delayed Post-Operative MRI Changes in Children with Pilocytic Astrocytoma

Wendy M. Goldstein, BS; Mark D. Krieger, MD; J. Gordon McComb, MD (Los Angeles, CA)

Introduction: Gross total resection of pilocytic astrocytoma (PA) in children is considered curative. We evaluated the risk of recurrence based on the following postoperative MRI features: gross gadolinium enhancement, marginal enhancement, and T2 signal changes.

Methods: Under an IRB approved protocol, a retrospective review was conducted of 48 children who underwent resection of PA over an 8 year period. (Optic pathway PAs were excluded.) Follow-up ranged from 1 year to 8 years (mean 4.5 years). MRIs obtained immediately postoperatively and at 3 months were evaluated for: gross residual tumor enhancement, marginal enhancement, and T2 signal change. Patient records were reviewed for disease course.

Results: 13/48 (27%) of patients had gross residual disease due to tumor location; 10/13 (77%) of these patients had disease progression. Of the 35 patients who had no gross residual disease, 7 had both T2 changes and marginal enhancement which persisted at 3 months. 5/7 (71%) of these patients had progressive disease. 13 patients had marginal enhancement only; 2/13 (15%) had progression. 4 patients had persistent T2 changes only, and none had disease progression. 11 patients had no residual enhancement and no persistent T2 changes; only 1/11 (9%) had disease recurrence.

Conclusions: Marginal enhancement and persistent T2 changes on MR imaging at 3 months postoperative indicate a risk of recurrence of pilocytic astrocytomas in children which is similar to the risk of recurrence with gross residual tumor.

ORAL ABSTRACTS

15. Seizure Outcome Following Surgical Resection of Dysembryoplastic Neuroepithelial Tumors in Children

Teda Arunrut; J. Gordon McComb, MD; Mark D. Krieger, MD (Los Angeles, CA)

Introduction: Dysembryoplastic neuroepithelial tumors (DNET) are rare, low-grade tumors that generally present with intractable seizures. This study evaluates the seizure outcomes of these patients in terms of surgical resection and MRI findings.

Methods: An IRB approved retrospective review was conducted of the medical records of 21 children who underwent surgical resection of DNET for epilepsy between May 1994 and May 2009.

Results: Average follow-up was 32 months and ranged from 4 months to 84 months. 15 patients underwent a gross total resection on MRI; of these, 13 are seizure free off antiepileptic drugs (AEDs). 2 patients with GTR and long histories of seizures (9 and 10 years) are still on AEDs for seizures. Six patients had subtotal resections; 4 of these are well-controlled on AEDs, and 2 had repeat resection and are now seizure free off AEDs. The magnetic resonance images of 10 patients in this study also displayed T2 hyperintensity in the cortical tissue surrounding the tumor site. Although two of these patients experienced recurrent seizures post-operatively, subsequent resection of the residual T2 change eradicated seizure activity.

Conclusions: Gross total resection is a highly effective means of controlling seizure activity in DNET patients. Patients with recurrent seizures and residual tumor or residual T2 changes should undergo a repeat resection. However, seizures may be intractable in patients with long seizure histories.

16. Long-Term Results of Interstitial Radiosurgery in Chiasmal/Hypothalamic Gliomas

Peter C. Warnke, MD, FRCS (Boston, MA); Ali Savas III, MD (Ankara, Turkey); Cristoph Ostertag, MD (Freiburg, Germany)

Introduction: Long-term results of interstitial radiosurgery in chiasmal/hypothalamic gliomas. The treatment of pilocytic astrocytomas in the chiasmal/hypothalamic region is controversial and mostly based on class II and III evidence. Virtually no longterm data beyond 5-year follow up exist. Whilst the use of external beam radiosurgery is limited by the dose to the optic nerves and the hypothalamus. Continuous low dose rate temporary interstitial radiosurgery has a much steeper dose fall off and is well-tolerated. We now report on its long-term efficacy.

Method: Out of 128 pilocytic astrocytomas we studied 55 chiasmal/hypothalamic tumors treated with 125-iodine interstitial radiosurgery and a median follow-up of 14 years. The median dose rate was 6 cGy/h and the median dose to the tumor margin was 60 Gy. The mean tumor volume was 14.2 cc. Only tumors with clinical or radiographic progression were treated. The ophthalmological and endocrinological status was monitored by independent investigators.

Result: The 5- and 10-year median survival was 85% and the progression free survival was 82 and 78 % respectively. Tumor control was achieved in 78.4 % with a volume reduction in 56.3%. Visual findings were improved in 9% and stabilized in 78.5 %. 37.5 % had an improved seizure frequency according to Engel. 94.5 of cases showed no change of the function of their hypothalamic-pituitary axis during follow-up.

Conclusion: Compared to surgery, radiotherapy and chemotherapy series interstitial radiosurgery renders excellent long-term tumor control with significant improvement of function and minimal endocrinological morbidity.

17. Findings on MRI Brain Used to Triage Pre-Operative Imaging of Neuraxis in Children with Cerebellar Neoplasms

Jonathan A. Forbes; Matthew Pearson, MD (Nashville, TN)

Introduction: Approximately 50-55% of all pediatric intracranial tumors arise from the cerebellum. Spinal staging is beneficial pre-operatively in medulloblastomas, ependymomas, and other high-grade neoplasms traditionally associated with an elevated risk of leptomeningeal spread. However, the price of MRI of the entire neuraxis with/without contrast (\$17,862 at our institution) is prohibitively high and does not appear to be cost-effective in those patients harboring juvenile pilocytic astrocytomas or other grade I lesions.

Methods: We have previously described a scoring system (FPW Score) able to correctly identify histology based on pre-operative MRI findings in 4 of 5 patients with a cerebellar neoplasm. Using FPW Score cutoff of -1 or less, we had obtained a sensitivity of 94% and specificity of 92% for identifying grade I lesions. We retrospectively reviewed the records of the original series of 42 patients to assess the utility of FPW Score in reduction of unnecessary MRI of neuraxis in those suspected to have a grade I lesion.

Results: 16 of 42 patients harbored grade I lesions. Pre-operative MRI of the neuraxis was obtained in 7 of the 16 patients. 6 of these 7 were correctly identified using FPW Score and could have retrospectively avoided MRI of the neuraxis, resulting in an estimated savings of \$107,172. No medulloblastomas or ependymomas were missed using the same criteria.

Conclusions: Children with cerebellar neoplastic lesions at low risk for leptomeningeal spread can be identified with high specificity using pre-operative findings on MRI of the brain and unnecessary MRI of the neuraxis can be avoided.

18. All Diffuse Intrinsic Pontine Gliomas Should be Biopsied

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

Introduction: Diffuse intrinsic pontine gliomas carry the grimmest prognosis of all pediatric brain tumors, and the standard of care has been that no biopsy is required. Patients are consigned to rapid death with either conventional radiation or often-not-benign Phase I therapy without tissue diagnosis. No progress has been made despite 20 years of trials. Biological markers are changing how we analyze and treat all other pediatric brain tumors.

Methods: Literature and personal experiences on this and similar tumors were reviewed.

Results: Nearly 400 cases have been reported on the accurate diagnosis of brainstem lesions by stereotactic biopsy. The complication rate is low, generally with transient symptoms. Mortality is below 1%. One series reported 3 tumor grades on biopsy; another, a misdiagnosis of grade in 23% by radiography alone; and another, 28% low grade gliomas. In another, 9 autopsies revealed 2 PNETs among the predicted malignant gliomas. Adequate tissue for histopathology, DNA and microRNA analysis may be obtained with as few as three passes with a stereotactic biopsy needle. Autopsy specimens cannot be obtained before unacceptable degradation of tissue has occurred.

Conclusions: Treatment outcomes may be confounded by inappropriately grouping together different tumors, misdiagnosis. Biological markers may predict outcome and direct therapy better than histology or radiology. The circumstances which led to the adoption of the current standard of care no longer apply, and benefits will accrue with more accurate diagnosis. The contemporary standard of care must change: stereotactically biopsy all diffuse pontine gliomas for accurate diagnosis and optimal treatment.

19. Influence of Dural Opening on Scoliosis in Patients with Chiari I Malformations

Todd C. Hankinson, MD (Birmingham, AL); Jason Wade; Saadi Ghatan, MD; Richard C.E. Anderson, MD; Neil A. Feldstein, MD (New York, NY)

Introduction: The use of duraplasty with posterior fossa decompression (PFD) for children with Chiari Malformation, Type I (CM-I) is debated. Few studies directly compare scoliosis response following PFD +/- duraplasty.

Methods: Single institution retrospective review of all patients with CM-I, syringomyelia and scoliosis treated surgically between January 1995 and May 2009. Outcomes included clinical and radiographic parameters pertaining to scoliosis.

Results: Thirty patients were treated. Prior to 2003, all patients underwent PFD with duraplasty. From 2003 onward, patients underwent PFD without duraplasty unless their clinical presentation included rapidly progressive neurological signs or scoliosis. Twelve patients (40.0%) underwent PFD without duraplasty and 18 (60.0%) underwent PFD with duraplasty. The mean preoperative and follow-up Cobb angles in the non-duraplasty group were 31.2 degrees and 33.9 degrees (+2.7 degrees). In the duraplasty group these measured 38.9 and 37.4 degrees (-1.5 degrees). Mean follow-up was 43.5 months. Two patients (16.7%) in the non-duraplasty group underwent reoperative PFD with dural opening due to progressive scoliosis. There was no significant difference in clinical outcomes among the two groups.

Conclusions: To our knowledge, this study represents the first direct comparison of PFD with or without duraplasty for the treatment of scoliosis in CM-I. We encourage the use of PFD with duraplasty when rapidly progressive neurological signs or scoliosis exist. However, our data suggest that the rate of scoliosis progression is not significantly different after PFD regardless of dural opening.

20. Initial Surgical Technique for the Treatment of Middle Fossa Arachnoid Cysts: Bi-Institutional Comparison of Results and Complications

Todd C. Hankinson, MD (Birmingham, NY); R. Shane Tubbs, PhD, PA-C (Birmingham, AL); Ivan Kotchetkov, BA; Richard C.E. Anderson, MD (New York, NY); Jeffrey Blount, MD; W. Jerry Oakes, MD (Birmingham, AL); Neil A. Feldstein, MD (New York, NY); John C. Wellons, MD (Birmingham, AL)

Introduction: Surgical techniques for the management of Middle Fossa Arachnoid Cysts (MFAC) are controversial. Options include fenestration (open or endoscopic), shunt placement (ventriculo- or cyst-peritoneal), and fenestration with shunt placement. No current data directly compare surgical techniques with regard to outcomes and complications.

Methods: Retrospective review of surgically treated MFACs at two children's hospitals. Data included presenting complaint, transverse cyst diameter, surgical procedure, clinical and radiologic responses following surgical intervention, and complications.

Results: Forty-two patients received surgical treatment. Thirty-two (76.2%) underwent fenestration without shunt placement (mean age 7.0 years) and 10 (23.8%) underwent fenestration with concomitant shunt placement or shunt placement alone (mean age 3.5 years). Fourteen patients (43.8%) experienced resolution of their presenting symptoms following fenestration without shunt placement. Four (40.0%) experienced resolution of their presenting

symptoms following shunt placement +/- fenestration. Fourteen patients (43.8%) in the shunt free group experienced complications requiring further surgery or readmission to the hospital. Among the 10 shunted patients, 6 (60.0%) had complications requiring reoperation or readmission to the hospital. Of 37 patients who had imaging sufficient for analysis, 16/28 (57.1%) without shunt placement and 5/9 (55.6%) of those with a shunt had a greater than 50% reduction in the transverse diameter of their cyst.

Conclusions: Data indicate that clinical and radiographic improvement rates are similar following surgical intervention for MFAC regardless of whether a shunt is placed. There is a suggestion that patients who receive a shunt at the initial surgery are more likely to require further surgical intervention or hospital admissions than those who do not.

21. Limited Access Craniosynostosis Surgery without Using Cranial Orthotics

Dean A. Hertzler, II, MD; Kerry Crone, MD; Todd Maugans, MD (Cincinnati, OH)

Introduction: Correction of infantile craniosynostosis using minimal access techniques has been described extensively. All major series have included patients who were routinely helmeted to promote remodeling; however, the importance of helmeting as it affects the ultimate cosmetic result is unknown. A scant amount of literature suggests that helmets may be unnecessary. We are presenting our recent cases of patients treated with minimal access approaches who were not helmeted.

Methods: A retrospective chart review was carried out for patient's undergoing minimal access procedures for synostosis during 2007-2009 at a single institution. Relevant preoperative, intraoperative and postoperative parameters were reviewed, including cranial morphometrics, radiographs and digital photographs.

Results: Fourteen patients were identified manifesting single suture stenosis: sagittal (6), non-syndromic coronal (2), metopic (6). The mean age at surgery was 9.6 weeks. No patient was helmeted postoperatively. Mean follow-up interval was 7 months, several more than one year. All patients demonstrated improvement in the cephalic index (CI). Overall aesthetic result was good to excellent as judged by parents and surgeon, and by serial digital photographs that were compared to cases from the literature. No patient has required reoperation.

Conclusions: This preliminary analysis support the impression of other groups that routine helmeting following minimal access procedures for craniosynostosis is unnecessary. Since previous investigators have demonstrated that changes in CI improve within the first 2-6 months and that regression is minor when it occurs, our limited follow up does not present a major limitation. This data advocates for a formal prospective trial to clearly define the role of postoperative helmeting.

ORAL ABSTRACTS

22. Endoscopic Transphenoidal Fenestration of Rathke Cleft Cysts in Children

Erin Kiehna, MD; Spencer C. Payne, MD (Charlottesville, VA); Edward R. Laws Jr., MD (Boston, MA); John A. Jane Jr., MD (Charlottesville, VA)

Introduction: Rathke cleft cysts (RCCs) are embryologic remnants of Rathke's pouch which are usually asymptomatic. For patients with headaches, visual changes or progressive enlargement, surgical intervention may be appropriate to reduce symptoms and prevent visual decline. We present our experience with endoscopic transphenoidal fenestration in the pediatric population.

Methods: We retrospectively reviewed the neuroimaging, operative notes and pathology reports of all patients with a RCC treated with a transphenoidal approach at the University of Virginia since 2005.

Results: We identified 44 patients that underwent endoscopic transphenoidal surgery for RCC, 8 of whom were children. Mean age was 15 years (range 8-18 years). Median follow-up was 17 months. There were 4 females and 4 males. Primary symptomatology was headache in all patients, associated with visual changes in one patient. Mean cyst diameter was 12 mm (range 5-18 mm). The RCCs were completely intrasellar 6 of 8 patients; the remaining two had suprasellar extension. All patients underwent an endoscopic transphenoidal fenestration. There was radiographic evidence of complete cyst drainage in all but one patient. Two patients had intraoperative cerebrospinal fluid leaks repaired with a fat graft and dural sealant. One patient experienced a symptomatic recurrence within 6 months; she underwent a second endoscopic transphenoidal fenestration complicated by epistaxis. Headaches improved in 6 of 8 patients postoperatively. The patient with visual loss improved. One patient developed diabetes insipidus postoperatively.

Conclusions: The endoscopic transphenoidal approach allows for minimally invasive fenestration of RCCs with symptomatic relief in the majority of patients. Patients should be closely monitored for endocrine abnormalities postoperatively.

23. Natural History of Intracranial Arachnoid Cysts in Children

Andrew Y. Yew, BS; Wajd N. Al-Holou, MD; Zackary Boomsaad, MD; Hugh J L Garton, MD, MHSc; Karin M. Muraszko, MD; Cormac O. Maher, MD (Ann Arbor, MI)

Introduction: Although arachnoid cysts are a frequent finding on intracranial imaging, the natural history of these cysts is not well defined.

Methods: We retrospectively reviewed the records of a consecutive series of 11,738 children who underwent brain MRI at a single institution. Radiographic images of the arachnoid cysts were analyzed for cyst size, cyst location, and other intracranial findings. Patients with follow-up imaging were identified, and the serial images were compared. In patients undergoing surgical treatment, the indications, treatment methods, and outcomes were analyzed. The data were evaluated using univariate and multivariate logistic and linear regression.

Results: We identified 273 arachnoid cysts, 112 of which had sufficient radiographic and clinical follow-up for natural history evaluation. After a mean follow-up of 3.4 years (range 4months-16.5 years), 11 cysts (10%) increased in size, 13 cysts (12%) decreased in size, and 88 cysts (79%) remained stable. Of the 273 patients with arachnoid cysts, 25 presented with symptoms, 3 developed new symptoms after long-term follow-up, and 23 (8.4%) underwent surgical treatment at our institution due to neurological symptoms. After multivariate analyses, we found that both a larger

initial cyst size and intracranial location in the anterior fossa were independently associated with the presence of symptoms ($P=0.0002$ & $P=0.007$ respectively) and surgical treatment ($P=0.0003$ & $P=0.004$ respectively). Older age at initial diagnosis predicted long-term stability of the arachnoid cysts ($P=0.001$).

Conclusions: Arachnoid cysts remain clinically and radiographically stable after long-term follow-up. Children diagnosed at a younger age are more likely to show cyst enlargement than older children.

24. Surgical Management for Cranial Congenital Dermal Sinus

Chiachien J. Wang, PhD; Tien T. Nguyen, MD; Mark D. Krieger, MD; J.Gordon McComb, MD (Los Angeles, CA)

Introduction: Congenital dermal sinus (CDS) is an embryologic defect that leads to communications between skin and underlying tissues. It can occur anywhere along the neuro-axis and is often associated with dermoid cysts. This study examines the treatment and outcome in regard to location of cranial CDS.

Methods: With IRB approval, we retrospectively reviewed records of patients surgically treated for cranial CDS between 1975 to 2009.

Results: 39 cases of cranial CDS were identified, with the majority located in the occipital (28/39-72%) and nasal (11/39-28%) regions. 10/11 of nasal CDS were in males, but no such predilection was seen in females. Nasal CDS (11/11 cases) were more likely to have an associated cyst than occipital CDS (18/28 cases). 25/39 of the cranial CDS extended through the cranium, and the tracts of occipital CDS had a higher propensity to extend through the dura matter. Neurological deficits upon presentation were observed in some occipital CDS, but not with any nasal CDS. Imaging was useful but not sensitive; MRI detected 25/39 of cases, with CT detecting only 5/39. Only 1 case recurred, but 3 cases of occipital CDS had wound infections.

Conclusions: Nasal CDS are less common than occipital CDS and have a more favorable outcome.

25. Treatment Practices for Chiari I Malformation with Syringomyelia

Brandon Rocque, MD (Madison, WI); Timothy George, MD, FACS (Austin, TX); John Kestle, MD (Salt Lake City, UT); Bermans J. Iskandar, MD (Madison, WI)

Introduction: The purpose of this study is to report the results of a survey of the American Society of Pediatric Neurosurgeons (ASPN) on treatment of Chiari I malformation with syringomyelia.

Methods: A questionnaire was circulated during the 2006 meeting of the ASPN, in which surgeons were surveyed on their management of patients with Chiari I and Syringomyelia. The survey consisted of questions about four clinical scenarios, common causes of surgical failures, and complications.

Results: There were 72 respondents, representing greater than 90% of attendees at the 2006 ASPN meeting. The majority of respondents (85%) perform posterior fossa decompression as first line treatment for Chiari I with Syringomyelia. Of those, 7% perform bony decompression alone, 46% open the dura, and 42% shrink the tonsils. Very few respondents offer syrinx drainage as first-line therapy (<3%). While all respondents treat symptomatic Chiari I/Syringomyelia patients surgically, 15% of respondents do not operate on asymptomatic patients. Finally, respondents stated that their most common complications are pseudomeningocele (49%) and chemical meningitis (43%).

Conclusion: This survey was given to a representative group of experienced North-American pediatric neurosurgeons. The majority of respondents perform posterior fossa decompression for Chiari I and Syringomyelia, regardless of symptoms. Although most surgeons open the dura, preferred techniques for decompression vary. Conservative follow-up is only used by a minority of respondents, and only in asymptomatic patients. Primary syrinx drainage is rarely utilized. A multi-center trial of surgical outcomes has been designed based on the information from this survey.

26. Incidence of Tethered Spinal Cord in Infants with VACTERL

Brent Oneill, MD (Seattle, WA); Elizabeth Tyler-Kaberra, MD, PhD; (Pittsburgh, PA)

Introduction: VACTERL is a non-random association of birth defects including vertebral malformations, anal atresia, cardiac anomalies, tracheo-esophageal fistula (TEF), renal anomalies, and limb malformations. Clinical experience and a few published case series [Kuo, Chestnut, Warf, Pang] suggest that tethered spinal cord (TSC) occur commonly in children with VACTERL, but to date, no study has defined the incidence of TSC in VACTERL patients. Such information would guide decisions about the appropriateness of screening spinal imaging.

Methods: Charts were reviewed of all patients discharged from the neonatal intensive care unit at Children's Hospital Pittsburgh in the past fourteen years with the diagnosis of VACTERL, TEF, or anal atresia. During that time period, our protocol has been to screen this population for TSC with spinal ultrasound. The charts were reviewed for the presence of a spinal cord tether requiring surgery and for the features of VACTERL.

Results: Thirty-three patients with VACTERL and adequate spinal imaging were identified. In thirteen of these (39%) a surgical spinal cord tether was identified. Among patients without VACTERL, those with anal atresia had a 7.9% incidence of TSC; those with TEF had a 2.4% incidence. False negative ultrasounds were found in 21.4% of patients with TSC.

Conclusions: Children with VACTERL should undergo MRI screening for TSC. Infants with anal atresia without VACTERL have a much lower incidence of TSC than those with VACTERL.

27. Symptom Response Patterns and Role of Duraplasty and Scoliosis in Re-Tethering in Post-Myelomeningocele Repair Tethered Cord Syndrome

Chetan Bettgowda, MD; Violette Renard, MD; David Ibrahim, MD; Ulrich Thomale, MD; Ed Ahn, MD; George I. Jallo, MD (Baltimore, MD)

Introduction: Symptom response to un-tethering, and the impact of duraplasty and scoliosis on re-tethering are poorly understood in post-myelomeningocele repair (PMR) TCS.

Method: We performed a review of 54 children with PMR TCS to determine the impact of un-tethering on symptoms, the impact of dural repair type on re-tethering, and the role of scoliosis on the incidence and time to re-tethering. The average age was 10.3±4.9 years with 44% males. The most common presenting symptoms of TCS were urinary (87%), motor (80%), gait (78%), and sensory (61%) dysfunction. The average post-operative time (months) to symptom improvement was 2.02 (sensory), 2.52 (weakness), 3.21 (pain), 3.5 (urinary), and 4.48 (motor). Sensory improvement occurred significantly earlier than motor improvement ($p = 0.02$). At last follow-up (average 47 months), symptom status was as follows [symptom (%improved/%maintained/%worsened)]; motor (26/62/11), sensory (26/71/3), weakness (100/0/0), pain (28/65/7), and urinary dysfunction (17/76/7).

Result: There was no difference in symptom response with type of dural repair (primary closure vs. duraplasty). Duration of symptom ($p = 0.88$), age at surgery ($p = 0.35$), or type of dural repair ($p = 0.15$) were not associated with re-tethering. Scoliosis was not associated with an increased incidence of re-tethering ($p = 0.15$), but was associated with significantly earlier re-tethering (32.5 vs 61.1 months; $p = 0.042$) in patients who re-tethered.

Conclusion: A characteristic pattern of symptom response following tethered cord release may be present. Duraplasty, pre-operative symptom duration, and age do not contribute to re-tethering. Re-tethering in the presence of scoliosis may occur significantly earlier.

28. Complete vs. Anterior 2/3rd Corpus Callosotomy in Children: Analysis of Outcome

Laleh Jalilian, MD (St Louis, MO); Alexander K. Powers, MD (Wake Forest University, NC); James Johnston, MD; David D. Limbrick, MD, PhD; Matthew D. Smyth, MD, FACS (St Louis, MO)

Introduction: Division of the corpus callosum is reserved for children with severe medically refractory epilepsy who would not otherwise benefit from epileptogenic tissue resection. Controversy remains over the extent of callosal sectioning. We report seizure outcome in patients who underwent anterior two-thirds or complete CC during the period 1995-2008 at St Louis Children's Hospital.

Methods: The medical records of 27 children (age 3 to 19 years, mean 9.93 years) with a minimum follow-up of 6 months were retrospectively evaluated. Seizure type, operative data, complications, postoperative seizure frequency, assessment of daily functioning, and changes in the number of prescribed anti-epileptic drugs (AEDs) were collected.

Results: 15 patients underwent anterior 2/3rds CC and 12 underwent complete CC. Of the 15 patients who underwent anterior callosotomy, 7 later received a posterior CC. Patients that did the best were those undergoing a single-stage complete callosotomy (84% Class I-III) vs. anterior 2/3rds (75% Class I-III). Seizure types most improved after CC included atonic, myoclonic, and absence. Patients who underwent anterior 2/3rds corpus callosotomy were more likely to experience a decrease in the number of AEDs prescribed as compared to those who underwent complete CC.

Conclusions: This study confirms that corpus callosotomy is safe and effective for managing severe refractory epilepsy in selected children. A complete callosotomy should be considered as the initial procedure in lower-functioning children less likely to be impacted by a disconnection syndrome. Completion callosotomy may benefit patients who have failed prior anterior callosotomy.

ORAL ABSTRACTS

29. Functional Mapping in Epileptic Patients with Varying Motor Control Using Spectral Changes in ECoG

Andrew S. Geneslaw, BS; Eun-Hyoung Park, PhD; Sheryl Manganaro, BS; Joseph Madsen, MD (Boston, MA)

Introduction: In patients with implanted subdural grids, recent studies have found that activity dependent spectral changes in the Chi frequency range (76-200 Hz) can localize to active areas of motor cortex (Miller 2007). We recorded ECoG from 3 patients, one with sufficiently limited left sided dexterity to be a hemispherectomy candidate. We suspected this subject would have a notably different motor ECoG signature.

Methods: Patients were cued to gesture with right or left foot or hand. Following the lead of Miller and Ojemann, resting and active recordings were filtered for the Chi frequency band, divided into 80 ms bins for each electrode, and used to compute power spectra. Motor task spectra were normalized by subtracting baseline spectra and dividing by standard deviation. Frequencies greater than 2 standard deviations were summed across windows, and results were mapped anatomically.

Results: Two patients with normal/near-normal motor dexterity showed cortical maps as previously reported with this technique. Most individual activations appeared on contralateral ECoG grids over prefrontal areas and pre-central gyrus. Ipsilateral tasks showed diffuse prefrontal activity. In a third patient with a hemiparetic "helper hand", activity of the contralateral hemisphere rarely localized to the pre-central gyrus. Prefrontal cortex showed diffuse activity, and was ultimately functionally disconnected without additional deficit.

Conclusion: Spectral power in the Chi frequency range can rapidly generate relatively accurate maps of motor cortex. Variations on these spectral power maps likely have clinical implications for some patients, including surgical planning for such procedures as functional hemispherectomies, large disconnections or resections.

30. Spinal Deformities Post Selective Dorsal Rhizotomy after the Pubertal Growth Spurt

Rajeet S. Saluja, MD; Jeff D. Golan, MD, FRCS(C); Michele Parolin, MD; Jeffery A. Hall, MD, FRCS(C); Gus O'Gorman, MD, FRCS(C); Chantal Poulin, MD, FRCS(C); Thierry E. Benaroch, MD, FRCS(C); Marie-Andree Cantin, MD, FRCS(C); Jean-Pierre Farmer, MD, FRCS(C) (Montreal, Canada)

Introduction: Selective dorsal rhizotomy (SDR) is an important treatment modality with good long-term efficacy for patients with spastic cerebral palsy. Some concern exists, however, regarding the development of spinal deformities in the long term as a result of the surgical procedure, compounded by the effect of the underlying condition. Our group previously examined the incidence of spinal deformities post-SDR but many patients in that study had not yet undergone their pubertal growth spurts. The current study looks specifically at the incidence of spinal deformities post-SDR after the pubertal growth spurt.

Methods: A review of the McGill SDR Project database identified 98 patients who underwent the procedure from 1991 to 2001 and had spinal imaging post-operatively. Pre-operative and post-operative AP Cobb angles, along with lateral thoracic, upper thoracolumbar, lower thoracolumbar, and lumbar angles were measured and recorded for each patient up to July 2009. 22 patients were identified who had imaging after the pubertal growth spurt.

Results: This cohort had a mean age at surgery of 6.3 years and mean follow-up of 11.2 years. On follow-up AP x-rays, 10 patients had some degree of scoliosis (Cobb angle >10°), none clinically significant (Cobb angle >25°) requiring bracing or surgical

intervention. On lateral x-rays, 6 patients had lumbar hyperlordosis while 5 had diminished lumbar lordosis. Furthermore, 3 patients had grade 1 spondylolisthesis. None of these abnormalities required any intervention.

Conclusions: Although many patients who underwent SDR developed spinal abnormalities, they were mainly mild and none required any intervention. These findings persisted even after the pubertal growth spurt.

31. Safety of Staged Epilepsy Surgery

David Harter, MD; Jonathan Roth, MD; Chad Carlson, MD; Orrin Devinsky, MD; Howard L. Weiner, MD (New York, NY)

Introduction: Surgical resection of an epileptic focus relies on accurate localization. In certain cases, invasive investigation including subdural and depth electrodes is necessary to define the focus accurately. Our epilepsy center has treated select children with poorly localized medically refractory epilepsy with a staged epilepsy surgical protocol, with at least one phase of invasive monitoring, and many were subsequently re-operated upon for further localization and resection of additional epileptic foci. The aim of this study was to determine the safety of this approach.

Methods: Data was retrospectively collected, including surgical details and complications.

Results: 161 children underwent 200 multistage procedures (>1 surgery during one hospital admission), and 496 total surgeries. Average age at surgery was 7y (8m-16.5y). 250 surgeries included resections, 189 were for electrode placement only. Cumulative number of surgeries per patient was 2-10 (average 3). Average duration of monitoring was 10 days (3-30). There were no deaths. Permanent complications included mild new neurological deficit (0.8%/operation), bone resorption (5%/multistage procedure), and hydrocephalus (3%/multistage procedure). Major complications included CNS or bone flap infections (0.6%/operation), intracranial hemorrhage, CSF leak, and a retained strip (0.2%/operation each). Minor complications were positive surveillance OR cultures in an asymptomatic patient (2.2%/multistage procedure), non-infectious fever (2%/operation), and wound complications (2.5%/multistage procedure). 30 complications necessitated additional surgical treatment, 6 immediate (<2 weeks), and 24 delayed.

Conclusions: Staged epilepsy surgery, with invasive electrode monitoring, is safe in children with poorly localized medically refractory epilepsy. The rate of major complications is low, and appears comparable to that associated with other elective neurosurgery.

32. MEG Passive Language Localization in Sedated Children

Frederick A. Boop, MD; Mark McManis, PhD; Freedom Perkins, MD; Mark Van Poppel, MD; Amy McGregor, MD; Dave Clarke, MD; James Wheless, MD (LeBonheur Children's Hospital, Memphis, TN)

Introduction: In the past, functional cortical mapping for language has been limited to intracarotid amobarbital tests, cortical stimulation or fMRI and has required an awake, cooperative patient. This study demonstrates that receptive speech can be reliably determined in infants and sedated patients by magnetoencephalography (MEG) using a passive language paradigm.

Methods: 15 children (8 females, 7 males) were studied prospectively with passive language mapping using a 4-D, Magnes 3600, 248 channel magnetoencephalography system. Ages ranged from 2 1/2 to 16 years. A 180 word continuous recognition module (CRM) was played via ear buds in each ear equally. The CRM

consisted of common English words presented as one word every two seconds. The volume was 85 dB. Patients either experienced natural sleep or received conscious sedation. Sleep was confirmed in stages I and II via simultaneous EEG monitoring.

Results: Magnetic field responses to the words were filtered and averaged. The average waveform was visually inspected and dipole sources were localized using an equivalent current dipole (ECD) model. Only sources between 250 and 800 ms post stimulus presentation were used to determine language laterality and Wernicke's area. Subsequent evoked fields were co-registered onto thin cut (2 mm) structural MRIs representing magnetic source imaging (MSI).

Conclusions: In 12/15 patients, activation of the dominant superior temporal gyrus (Wernicke's area) was identified (7-left, 2-right, 3-bilateral). In three, artifact from their vns precluded interpretation. To date, no patient has suffered a new language deficit following resective surgery guided by this passive language acquisition. The technique and surgical details will be presented.

33. Corpus Callosotomy Outcomes: The Denver Children's Experience

Elisa J. Kucia, MD; Susan Koh, MD; Paul M. Levisohn, MD; Kelly Knupp, MD; Pramote Laoprasert, MD; Michael Handler, MD (Denver, CO)

Introduction: There have been several reports of the effectiveness of corpus callosotomy (CC) for drop seizures, but only one prior study compares anterior 2/3 to complete callosotomy.

Methods: This is a retrospective analysis of 19 children who underwent CC for seizure control between 1997-2008.

Results: Seven underwent anterior, 9 underwent complete, and 3 underwent anterior callosotomy later extended to complete resection. Age at surgery ranged from 5 to 20 years. All except one patient had daily generalized myoclonic, atonic or tonic seizures intractable to medical therapy. One patient had complex partial seizures with multifocal onset associated with drops. 13 had vagal nerve stimulators (VNS) implanted prior to CC, and one afterwards. Median follow-up was 2 years, and minimum follow up 1 year. 5/10 patients (50%) with anterior CC had improvement of seizures, while 7/9 (78%) improved after a complete. Only 1/3 patients had improvement after completion of the callosotomy at a second operation. Overall, 13/19 had reduction in drop seizures of 50% or more and improved alertness and behavior. 4 were free of drop seizures, and one was completely seizure free. Recurrence of seizures was seen in three patients after full callosotomy. Four patients suffered transient complications. No added benefit was seen with the combination of VNS and CC.

Conclusions: CC helped significantly in 68% of patients with drop seizures. 26% of patients were free of drop seizures. Single stage complete callosotomies appear more effective than anterior callosotomies. No significant change in seizure frequency was noted with the combination of VNS and CC.

34. Seizure Localization in Pediatric Patients Using Spectral Clustering of Infra-Slow Oscillations in Gamma Band Power

Andrew L. Ko, MD; Jeffrey Ojemann, MD; Samuel Browd, MD, PhD; Edward Novotny, MD (Seattle, WA)

Introduction: Infra-slow (<0.5 Hz) changes in electrophysiological activity are useful for localizing partial seizures. The ictal shifts noted on EEG and ECoG are of large amplitude and imply an underlying physiological generator distinct from conventional electrographic changes. Using infra-slow oscillations in gamma (70-100Hz) band-limited power and a clustering algorithm, we successfully localize seizure foci in pediatric patients.

Methods: Electrocorticography was performed in three patients undergoing long-term invasive electrode monitoring for treatment of medically-intractable epilepsy at Seattle Children's Hospital, using standard clinical parameters on XLTEK amplifiers. A low-pass filter (<0.1 Hz) was applied to gamma band-limited power time series generated over long (9000 sec) artifact- and seizure-free recordings. Spatial correlation in this infra-slow signal was calculated between all electrode pairs, and a spectral clustering algorithm applied. Clusters generated were compared to seizure localization performed by epileptologists.

Results: We examined 310 electrodes. Epileptologists identified 32 electrodes with ictal activity. Our algorithm localized seizure activity to 28 electrodes. Four were falsely positive, and eight ictal electrodes were not identified by our algorithm. Our algorithm has a sensitivity and specificity of 75% and 98.6%, respectively, and a positive predictive value of 85.71 (67-98) and a negative predictive value of 97.16 (94-98).

Conclusion: This study uses infra-slow correlations in gamma band-limited power to localize seizure foci with good accuracy during seizure-free recordings. Changes in gamma band power are known to reflect local cortical activity, implying that correlated, infra-slow oscillations in neuronal activity characterize ictal foci.

35. Histological Evidence for the Significance of the Intraoperative Monitoring in Selective Dorsal Rhizotomy

Tomohisa Shimizu, MD; Toru Fukuhara, MD, PhD; Yoichiro Namba, MD (Okayama, Japan)

Introduction: It has been advocated that the intraoperative monitoring is mandatory in selective dorsal rhizotomy. However, the clinical studies without the monitoring are sparse, that leads to the lack of evidence indicating the better outcome of children operated with the intraoperative monitoring.

Methods: Seven children with cerebral palsy underwent selective dorsal rhizotomy on the same protocol. The pieces of their sectioned nerve rootlets from L5 were examined histologically using the electron microscopy. In each patient, two nerve rootlets; one with the most abnormal reaction against the intraoperative electrical stimulation and the other with the least abnormal reaction were examined. The electron microscopy findings of the rootlets were compared with the reactions against the intraoperative stimulation.

Results: Among 14 examined nerve rootlets, the definite abnormal reactions were seen in 5, which were 4 clonus and one bilateral reaction. In other 9 rootlets, EMG findings were normal, however, due to hyperactive reactions they were sectioned per our protocol. All 5 rootlets with abnormal reactions showed demyelinations with axonal degeneration. On the contrary, in 9 hyperactive rootlets with normal EMG, 3 rootlets had normal findings, 5 had only minimum changes on myelin sheath and one had demyelination without axonal degeneration.

Conclusion: The nerve rootlets with the abnormal reactions against the intraoperative stimulation have more histological degenerations. This proves the intraoperative monitoring is meaningful method to identify the nerve rootlets to be sectioned.

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36. Clinical Outcomes and Functional Recovery Following Supplementary Motor Area Resection in Pediatric Non-Lesional Epilepsy Surgery

Charles B. Stevenson, MD; James Leach, MD; Joo-Hee Seo, MD; Ki Lee, MD; Katherine Holland, MD, PhD; Anna Byars, PhD (Cincinnati, OH); Matthew Smyth, MD (St. Louis, MO); Francesco Mangano, DO (Cincinnati, OH)

Introduction: Located within the superior frontal gyrus, the supplementary motor area (SMA) participates in the initiation and execution of voluntary movements, including speech expression. Clinical deficits typical of SMA injury have been extensively characterized, as well as correlated with preoperative functional MRI (fMRI) mapping, in adult patients undergoing resection of frontal lobe gliomas. However, functional recoveries following SMA resection, and the accuracy of fMRI in predicting SMA-related deficits, have not been studied in children.

Methods: We retrospectively reviewed the charts of patients undergoing resective surgery for intractable epilepsy at Cincinnati Children's and St. Louis Children's Hospitals between 2004 and 2009. Eleven children with non-lesional superior frontal lobe resections, 10 of whom had undergone preoperative fMRI, were identified.

Results: Postoperative imaging confirmed at least partial SMA resection, as defined by anatomic landmarks, in all cases. Nine children demonstrated deficits immediately postoperatively; only one had residual weakness six weeks postsurgery. Presence of deficits directly correlated with the posterior resection margin's proximity to the precentral sulcus. Analogously, postoperative deficits consistently corresponded to extent of resection of SMA activation areas delineated on fMRI. All patients were seizure free at last followup and demonstrated either improvement or no change in performance on formal neurocognitive testing.

Conclusions: Localization of an epileptogenic focus to the SMA should not preclude therapeutic resection--these children typically have excellent clinical outcomes and full functional recovery. fMRI accurately localizes the SMA, and in conjunction with the proposed resection plan, may be utilized to determine the risk of postoperative deficits in children undergoing surgery for frontal lobe epilepsy.

37. Decompressive Craniectomy for Trauma in Children: Is it Worth it? A Critical Look at 75 Patients

Christina Notarianni, MD; Stephanie Einhaus, MD; Frederick Boop, MD; Robert Sanford, MD; Shelly Timmons, MD, PhD; Daniel Kueter, MD; Michael Muhlbauer, MD (Memphis, TN)

Introduction: Decompressive craniectomy is used for the management of persistent elevated intracranial pressures in traumatic brain injury. In children, the literature on this intervention is comprised of small case series, limiting conclusive results.

Methods: A retrospective study was conducted on all pediatric head trauma patients treated with decompressive craniectomy from January 1999 to April 2009. A total of 75 patients were included in the study. Factors reviewed included: age, admission Glasgow Coma Score (GCS), radiologic findings, surgical procedure(s), Glasgow Outcome Score (GOS) at 6 month follow-up.

Results: Patient age ranged from 11 months to 18 years, with a mean age of 13 years. Admission GCS score ranged from 3-8. 85% of craniectomies included evacuation of a mass lesion. 7 patients died during their initial hospital course, and all had an admission GCS of 3 or 4. 66% (45/68) of subjects had a 6 month GOS of 4-5, 9% (6/68) had a GOS of 3, and 25% (17/68) had GOS of 1-2. The majority of patients with an admission GCS of 6 or greater had good neurologic recovery (GOS 4-5). All patients with admission GCS of 4 or less were vegetative or deceased at 6 month follow-up.

Conclusion: This is the largest retrospective series to date analyzing the use of decompressive craniectomy in pediatric head trauma. Using this procedure at early stages of ICP management in patients with an admission GCS of 6 or greater provides the best chance for good neurological outcome in these critical patients.

38. Concussions in Pediatric Patients: Preliminary Results Using Diffusion Tensor Imaging, Functional MRI and Neuropsychological Testing

Rajeet S. Saluja, MD; Jen-Kai Chen, PhD; Rosanne Aleong, PhD; Gabriel Leonard, PhD; Sierra Debenham; Tomas Paus, PhD (Montreal, Canada); Michelle Keightley, PhD (Toronto, Canada); Isabelle Gagnon, PhD; Alain Ptito, PhD (Montreal, Canada)

Introduction: Concussions in children account for 75-85% of all pediatric head injuries, and many of these children suffer from persistent cognitive deficits lasting weeks or months. Although considerable work has been done to determine the effects of concussions in adults using various imaging techniques, little has been done in the pediatric population.

Methods: Concussed children aged 10-17 were recruited from the Montreal Children's Hospital and clinical referrals. Each subject was matched for age and sex to five control subjects. To date, 10 concussed children and 50 controls have been recruited. Each underwent fMRI (performing visual/verbal working memory and spatial navigation tasks), DTI, and neuropsychological testing. The DTI sequences were analyzed using voxel-based analyses and tract-based spatial statistics, and corroborated with data obtained from fMRI and neuropsychological testing.

Results: Preliminary results suggest that fractional anisotropy maps from children with concussions differ from those of matched controls in multiple areas including regions adjacent to the dorsolateral prefrontal cortex, thalamus, and mesial temporal structures. The fMRI results support these findings since a lack of BOLD response was noted in these regions during the working memory and navigation tasks. Neuropsychological data also support these findings with deficits observed in Rey figure delayed recall and STROOP tests.

Conclusion: These results suggest that small areas of white matter damage, particularly near the dorsolateral prefrontal cortex and thalamus may be present following concussions in children. Abnormal neuropsychological profiles and fMRI results corroborate these findings as significantly lower BOLD signal changes are observed in corresponding regions of cortex.

39. Cervical Spine Clearance in the Pediatric Trauma Population

Praful Maste, MD; Paul Porensky, MD; Promod Pillai, MD; Corey Raffel, MD, PhD; Ronald T. Grondin, MD, FRCS(C) (Columbus, OH)

Introduction: Cervical spine injuries (CSI) are rare in children. Current recommendations for cervical spine evaluation in children include lateral and anteroposterior films in symptomatic patients and odontoid views in patients older than 9 years. Patients with persistent neck pain are often placed in cervical collars and reassessed by a neurosurgeon. The purpose of this study was to identify what proportion of patients with normal imaging, discharged in a cervical collar had unidentified injury requiring further intervention.

Methods: We retrospectively reviewed 285 patients referred to neurosurgery clinic for cervical spine clearance.

Results: 285 patients referred to neurosurgery clinic with suspected CSI between January 2007 and June 2009 were identified. Common presentations were motor vehicle accidents, falls, including falls from trampolines, and sport related injuries. Of 285 patients, 269 patients had normal X-rays by both radiology reports and neurosurgeon interpretation. There were no cases in which the radiology report differed from the neurosurgeon's interpretation. Of 16 patients with abnormal X-rays, three had clinically significant injuries requiring further management. Of 269 patients with normal plain films, 44 patients underwent further evaluation with flexion-extension X-rays; none of these demonstrated radiographic instability. No patient with normal static plain films demonstrated clinical instability.

Conclusions: Of 269 patients with normal plain films, no patient had a clinically significant cervical spine injury. A larger prospective study of patients with possible CSI may better quantify the risk of clinically significant CSI. Better quantification of this risk may allow for more focused guidelines for the clearance of cervical spine, and better utilization of clinical resources.

40. High Folate Diet in the Rat Significantly Increases Neural Regeneration after Spinal Cord Injury

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Introduction: Our group has previously shown that intraperitoneal injections of folic acid caused a dose-dependent improvement in neural regeneration after spinal cord injury in rodents. In an effort to determine the clinical applicability of this intervention, we examined the effect of an oral high folate (high methyl) diet on spinal regeneration.

Methods: Adult Sprague-Dawley rats were fed methyl-supplemented diets for 1 week prior to spinal cord injury. A dorsal column transection injury at C3 was made and a sciatic nerve graft was implanted at the injury site. Two weeks later, regenerated axons at the free end of the graft were backfilled with a retrograde fluorescent tracer. The DRG cell bodies of these regenerated sensory axons were counted. Additional biochemical and molecular confirmatory experiments were performed.

Results: Oral high folate diet increased the regeneration of spinal axons into a peripheral nerve graft in rats 6-fold, compared to control rats (6% vs. 1%, t test $p < 0.05$). Detailed analyses including folate doses and levels will be reported.

Conclusion: Oral supplementation improves spinal cord regeneration after injury in vivo, thus further substantiating the importance of folate in CNS repair. If confirmed in humans, this effect may provide a cost-effective and easily deliverable intervention to treat the injured CNS, thus potentially being beneficial in degenerative, developmental, and traumatic neurological diseases.

41. Prognosis for Children in Cardiac Arrest Shortly after Blunt Cranial Trauma

Lars Widdel, MD (Aurora, CO); Kathryn Beauchamp, MD (Denver, CO); Ken R. Winston, MD (Aurora, CO)

Introduction: The outcomes after aggressive cardiopulmonary resuscitation (CPR) in children who experience cardiac arrest shortly after blunt cranial trauma are assessed.

Methods: A retrospective analysis of all children who, within a 6 year period, suffered cardiac arrest at the scene of injury period, during transport or in the emergency department of a level one pediatric trauma center, as a consequence of blunt cranial trauma without associated major non cranial trauma were reviewed.

Results: 40 children with ages ranging from 1 month to 16 years met the inclusion criteria. 42% were passengers in motor vehicles and 32 % were victims of non-accidental trauma. Eleven of the 17 children in motor vehicle accidents were unrestrained. Eleven of the unrestrained children, plus two who were restrained, were ejected at the time of impact. All had a Glasgow Coma Score of 3 at the scene of injury. Average CPR time was 36 (2-107) minutes. A sinus rhythm was established in 50 % but was not sustained in most. The sole survivor was an 8 year old boy who was ejected and had asystole at the scene with return to sinus rhythm after 2 minutes of CPR.

Conclusions: The mortality was 97.5 % in 40 consecutive children with well documented cardiac arrest caused by blunt cranial trauma. Upon review of this series and others published reports; the authors conclude that, in pediatric victims of isolated blunt cranial trauma, aggressive cardiopulmonary resuscitation is rarely successful after 10 minutes and futile after 20 minutes.

42. Retroclival Epidural Hematoma: Clinical Characteristics and Diagnostic Technique

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Introduction: Retroclival Epidural Hematomas (REDH) represent 1.2-12.9% of EDH. Thirteen of the 14 reported cases occurred in children. REDH is likely underdiagnosed due to artifact in the posterior cranial fossa on axial CT.

Methods: Prospective collection of data regarding all patients diagnosed with REDH from July 2006 through June 2009. Data included mechanism of injury, GCS, neurological examination, treatment modality, and outcome. MRI was utilized to measure hematoma dimensions.

Results: Eight children were diagnosed with REDH, all secondary to motor vehicle related trauma. Mean age was 12 years (range 4-17y). Mean hematoma height (craniocaudal) was 4.0 cm (range 3.0-5.5 cm) and thickness (dorsoventral) was 1.0 cm (range 0.5-2.0 cm). Mean GCS was 8 (range 3-14). There was no correlation between hematoma size and presenting symptoms. Two patients died soon after injury. Two additional patients suffered atlanto-occipital dislocation, requiring surgical intervention. No patient underwent hematoma evacuation. Mean follow-up was 14 months (range 4-35 months). Four patients are neurologically intact, 1 patient has a complete spinal cord injury, and 1 patient has mild bilateral abducens nerve palsies.

Conclusions: To our knowledge, this represents the largest series of REDH reported. REDH occurs almost exclusively in children following motor vehicle related trauma. The anatomic basis of REDH may relate to the contribution of ligamentous structures and the stability of the pediatric craniocervical junction. Posterior dislocation of the tectorial membrane may disrupt periclavicular vascular structures. AOD must be considered in all cases of REDH. Hematomas themselves rarely require evacuation. Radiological evaluation should include sagittal plane imaging.

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43. Cell Proliferation and Neuronal Migration after Closed Head Injury in the Immature Piglet

Symeon Missios, MD; Brent Harris, MD, PhD; Michael Simoni, BS; Tarek Radwan, MD; Beth Costine, PhD; Carter Dodge, MD; Simon Hillier, MD; Leslie B. Adams; Ijeoma S. Chinwuba; Kate Hillier; Ann-Christine Duhaime, MD (Lebanon, NH)

Introduction: Neurogenesis following trauma has been reported in rodents, involving both the hippocampus and the subventricular zone (SVZ). To date, trauma-induced neurogenesis has not been reported in gyrencephalic animals. We used a piglet scaled cortical injury model to study trauma-induced neural repair in this intermediate species.

Methods: The structure of the immature porcine SVZ at three different ages was established using histology and immunofluorescence. The areas of the subependymal component (SE) and islands of immature neurons in the SVZ were measured one week after scaled cortical injury, comparing the injured to the uninjured hemisphere. Additional subjects were injected with 5-bromo-2-deoxyuridine (BrdU), and doublecortin (DC) positive cells were counted using confocal microscopy in a blinded fashion in the white matter of the injured and uninjured hemispheres.

Results: 61 subjects were studied. The SE and/or DC-positive island area was larger on the injured versus the uninjured side in the youngest subjects ($p < 0.05$). In the youngest subjects, migrating immature neurons were seen in the white matter and in greater numbers on the injured side, although most were BrdU negative.

Conclusions: Cortical injury is associated with increased numbers of immature neurons in young porcine subjects, a process that appears age-dependent and may affect outcome. The dramatic neurogenesis seen in rodent models was not identified in this model, and most migratory neurons did not appear newly generated after injury. Whether migrating immature neurons are beneficial or maladaptive after trauma in the gyrencephalic brain remains to be determined.

44. Wartime Pediatric Neurosurgery: The Experience in Afghanistan during Operation Enduring Freedom

Paul Klimo, MD, MPH (WPAFB, OH); Brian Ragel, MD (Portland, OR); William Scott, DO (Las Vegas, NV)

Introduction: Since October 2007, the US Air Force has been providing a single neurosurgeon for a 4-6 month tour stationed at Bagram Air Field (BAF), Afghanistan in support of Operation Enduring Freedom. The types of pediatric cases that have been done, lessons learned and the challenging conditions that military neurosurgeons face are discussed.

Methods: A review of a prospective database established in Oct 2007 was performed to extract all cases of patients aged 18 or less.

Results: From Oct 2007 to June 2009, 38 children underwent 50 operations. These 50 cases represented 26% of all neurosurgical cases over the same time period. There were 23 males, 16 females with an average age of 7.5 years (range, 10days-18years). All patients were local Afghans except one enemy combatant. Cranial procedures were the most common (45/50); 5 spinal cases were done. 39 cases were performed for trauma related injuries, 28 of them being combat-related trauma (GSW, IED, mortars, mines etc.). This included 13 craniotomies or craniectomies for penetrating brain injury. Twenty-two humanitarian cases were performed for reasons such as hydrocephalus, non-combat related head injuries, and congenital anomalies.

Conclusions: Although the treatment of children is not the primary mission, they constitute approximately a quarter of the neurosurgical caseload at BAF. Many of these cases are a direct consequence of the current conflict; humanitarian cases are performed when possible. Given the indefinite nature of our presence in Afghanistan, neurosurgeons will continue to care for children despite the challenging environment.

45. Serial Radiography in Abusive Head Trauma: A Penn State Update

Mark S. Dias, MD; Ray K. Bradford, BS; Arabinda Choudhary, MD (Hershey, PA)

Introduction: The appearance and evolution of radiographic abnormalities following abusive head trauma (AHT) is important for timing the injury. We analyzed a large group of infants with AHT to study the appearance and evolution of radiological (CT, MRI) abnormalities.

Methods: All children < 24 months with AHT were identified from medical records; the time of injury was determined clinically. All imaging studies were analyzed and the appearance and evolution of abnormalities was chronicled on serial imaging studies from the time of the injury.

Results: 102 children had specific injury dates and at least one imaging study; a subset of 41 children additionally had documented times of injury. Of this group 27 had only hyperdense subdural hemorrhage (SDH) on initial CT scans; the evolution of SDH was followed over time. The initial development of a hypodense component followed a bimodal distribution with an early peak averaging 28 hours (12.5 to 49 hours), and a later peak averaging 541 hours (126 to 3270 hours). The earliest time to complete disappearance of the hyperdense SDH component averaged 38 days (3 to 138 days). Parenchymal hypodensities appeared as early as 1 hour after the injury and were common within 24 hours. Additional analyses of CT, MRI (brain and cervical spine) and MRV will be presented.

Conclusions: These data extend the preliminary data by Dias et al (1998), and provide a framework upon which injuries in AHT can be timed as well as the limitations on such timing estimates.

46. The Human and Rat Filum Terminale: A Novel Source of Multipotent Cells

Ruchira M. Jha, MD; Joseph Madsen, MD; Ryan Chrenek, BA; Xiaojin Liu, PhD; David L. Cardozo, PhD (Boston, MA)

Introduction: Neural stem cells (NSCs) are multipotent cells arising from specific germinative-zones in the CNS. Unlike previously isolated mammalian CNS NSCs, the filum terminale (FT) is surgically accessible and serves no essential function in humans; minimally-invasive resection of a piece of FT is routinely performed in cord untetherings. We hypothesized that this may be a potential source of NSCs due to its unique developmental history of 'de differentiation' and histological niche. The advantage of this source of NSCs is that it provides an expendable source of autologous human NSCs for therapeutic use.

Methods: (Rat and Human models): FT was dissected from postnatal rats, or obtained from excess tissue from children undergoing tethered-cord release. Specimen tissue was stained for the NSC-marker Nestin, and cultured under conditions for isolation of NSCs, differentiation and characterization.

Results: FT stains positive for Nestin in-vivo. Using growth factors (e.g. EGF, bFGF, LIF), we isolated neurospheres in-vitro from rat-FT and human-FT derived from tethered-cord surgeries. When subject to appropriate differentiating conditions (adhesive-substrate, serum), FT-neurospheres gave rise to multiple cell types including neural-progenitor-cells, neurons and glia. In 19 experiments (with FT from 3 patients), we generated motor neurons (MNs) in-vitro under controlled conditions (100% of those tested). When FT-neurospheres were treated with the appropriate motor neuron growth factors and signaling molecules such as retinoic-acid and sonic-hedgehog, the generated MNs formed neuro-muscular-junctions with rat myocytes in-vitro.

Conclusions: Human and rat-FT is a novel source of multipotent cells, which has exciting potential implications for autologous therapies for many currently incurable CNS diseases in humans including degenerative and autoimmune diseases.

47. Atlantal Hemi-Rings and Cranial-Cervical Instability:

Identification, Clinical Characteristics, and Management

Taryn M. Bragg, MD, MS; Douglas L. Brockmeyer, MD (Salt Lake City, UT)

Introduction: Instability at the cranial-cervical junction in young children can be difficult to diagnose and treat. In the present study, the authors identified a subset of patients with atlantal hemi-rings as part of their radiographic and clinical presentation. We assessed their presenting data to identify factors predictive of cranial-cervical instability.

Methods: From our cranial-cervical disorders program, 17 patients were identified with atlantal hemi-rings, defined as bony discontinuity of the C1 ring in conjunction with lateral displacement of the C1 lateral masses (coronal CT). Clinical and radiographic characteristics were analyzed, including patient age at presentation, amount of occipital-cervical motion, amount of C1 lateral mass displacement, associated cranial-cervical anomalies (assimilation of the atlas, dysplasia of the occipital condyles, aplasia of the dens, os odontoidum, and Klippel-feil syndrome), integrity of the transverse ligament, and the presence of neurological deficit.

Results: The mean patient age at presentation was 2.2 years (range birth to 9 years). The mean amount of occipital-cervical motion was 9 mm (range 5-20 mm). Six patients required occipital-cervical fusion at the time of presentation. Eleven patients were followed for a mean of 26 months and four ultimately underwent surgical intervention. Surgery was recommended for five of the remaining seven children.

Conclusion: This is the first report to describe in detail the radiographic and clinical characteristics of patients with atlantal hemi-rings and cranial-cervical instability. We believe this anomaly is the underlying cause of progressive instability in a significant proportion of patients with cranial-cervical abnormalities. The presence of atlantal hemi-rings should prompt immediate and thorough neurosurgical evaluation.

48. Positional Plagiocephaly Management at the Children's Hospital of Eastern Ontario- Long Term Outcomes

Michael Vassilyadi, MD, FRCSC; Mohammed F. Shamji, MD, PhD; Praneal Merchant, BSC; Elana C. Fric-Shamji, MD; Karen Dube, RN, NP; Enrique C.G. Ventureyra, MD, FRCS(C) (Ottawa, Canada)

Introduction: The long-term effects of occipital positional plagiocephaly (OPP) on development are not well established.

Methods: 342 survey questionnaires were mailed to parents of children treated for plagiocephaly between 1996 and 2000. Categorical responses were obtained about subjective cosmetic outcome, school performance, language skills, cognitive development and societal function. Pearson coefficient analyses were performed.

Results: Eighty parents responded; 58 had children with right sided OPP and 22 with left. Positional therapy was uniformly applied and helmet orthosis utilized in 36%. Median age at follow-up was 9 years, with normal ultimate head appearance observed in 75% of children; 4% of parents and 9% of children observed significant residual asymmetry. These results did not vary by gender, age or side of plagiocephaly ($p>0.05$). Children with left OPP were observed to have worse language development and academic performance than right plagiocephaly. There were expressive speech concerns in twice as many with left OPP (36% versus 16%, $p=0.04$) along with three-fold greater special education requirements (23% versus 7%, $p=0.04$). There were no differences in comprehension or motor function by side of plagiocephaly.

Conclusions: Non-surgical management of plagiocephaly achieved good cosmetic outcomes. Children with left OPP more commonly encountered difficulties with cognitive and scholastic endeavors. This study was underpowered by the low (29%) response rate, taking into consideration the number of surveys that were not returned. Of value to know is that 80% of parents have no concerns about their child's head shape with 4% perceiving a significant residual asymmetry and 94% of the children are at age appropriate grades.

49. A Method for Early Correction of Anterior Calvarial Craniosynostosis Using Minimally Invasive Orbital Advancement

Ian M. Heger, MD (Jacksonville, FL); Eric Stelnicki, MD; Ari-Yuri Camargo (Hollywood, FL)

Introduction: Premature fusion of the sutures involving the anterior cranial vault provides unique challenges. In addition to the fused suture, abnormal growth along the endocranial base leads to complex craniofacial disorders. It has been suggested that early surgical intervention can help preempt the development of the various craniofacial disorders, but this has been met with mixed results. We report our experience with a minimally invasive technique for correction of coronal synostosis.

Methods: Over a 55 month period, 66 surgical procedures for craniosynostosis were performed. Of the 66 procedures, 20 orbital advancements were performed for either coronal or metopic synostosis. 7 procedures were performed in the standard, open approach via a bicoronal incision whereas 13 were done utilizing a newly described minimally invasive technique with endoscopic assistance.

Results: There were no complications from the procedure and no patient required intraoperative conversion to an open procedure. Comparing the open group to the minimal invasive surgery, the minimally invasive surgery was associated with a decreases length of stay and a trend toward less blood loss and a shorter operative time. Craniometric analysis showed that along withwith cranial orthotic molding, patient's heads developed a more symmetric shape. Patient were followed for a mean of 15.6 months, with only one patient (7.6%) who underwent a minimally invasive procedure requiring an open cranial vault procedure.

Conclusions: Minimally invasive correction of unicoronal synostosis is a safe and effective treatment. It has numerous advantages over the traditional repair; however a larger series with longer followup is required.

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50. Successful Resection of Cystic Hygromas of the Neck Involving the Brachial Plexus

Daniel Harmon, MD; Todd C. Hankinson, MD; Nadine Bradley, BSN, RN; Chevis Shannon, MBA; R. Shane Tubbs, PhD, PA-C; John C. Wellons, MD (Birmingham, AL)

Introduction: Cystic hygromas and lymphatic malformations of the lateral neck extending into the upper chest can adhere to, encompass, or compress portions of the brachial plexus. These challenging lesions require a multidisciplinary surgical team (neurosurgery, pediatric surgery, ENT, and/or orthopedics) for safe successful resection. This case series reviews our experience with cystic hygromas of this region.

Methods: By searching the electronic medical record for all children undergoing removal of a neck mass that involved pediatric neurosurgical intervention from 2005 until 2008, 6 children were identified. Three of the lesions were cystic hygromas and were operated on utilizing a multidisciplinary surgical approach. Imaging and postoperative neurologic outcomes were reviewed.

Results: All 3 lesions were adjacent to or encompassing portions of the brachial plexus or ansa cervicalis. Gross total or near total surgical resection was achieved in all three. One patient presented with symptoms of neurological compression that resolved postoperatively. No postoperative neurologic deficits were detected and no lesion has recurred.

Conclusions: The role of the pediatric brachial plexus surgeon is crucial in the resection of cystic hygromas involving the brachial plexus. Modifications to standard approaches to the brachial plexus are useful in large neck exposures. Total or near-total resection can be safely obtained while preserving neurologic function.

51. Maternal Embryonic Leucine Zipper Kinase is an Enrichment Marker for Tumor-Initiating Cells in Medulloblastomas and Plays a Key Role in Their Proliferation

Lissa C. Baird, MD; Amber Miller, MS; Hal S. Meltzer, MD; Michael L. Levy, MD, PhD; Alexey Terskikh, PhD (San Diego, CA)

Introduction: Prior studies have demonstrated a correlation between MELK expression and the pathologic grade of brain tumors, with particularly high expression noted in medulloblastomas. Other studies have identified subpopulations of CD133-positive cells in human medulloblastomas that demonstrate a marked capacity for self-renewal and proliferation. Our aim was to determine if MELK expression could be used to identify these tumor-initiating cells and if MELK inhibition would then impede their proliferation.

Methods: Medulloblastoma cell lines were established from primary human tumors and transduced with a MELK-GFP reporter. The cells expressing the highest and lowest 5% of MELK-GFP were isolated using flow cytometry. Correlation with CD133 expression was demonstrated with immunofluorescent quantification. MELK knockdown by siRNA was used to demonstrate requirement of MELK catalytic activity for tumor growth in vitro. Medulloblastoma cells were also treated in vitro with the small molecule MELK inhibitor NCI8.

Results: Tumor cells expressing higher levels of MELK-GFP were found to express 2-4 fold greater levels of CD133 expression than cells expressing low levels of MELK-GFP. These MELK-high cells also demonstrated greater inhibition of proliferation after treatment with the small-molecule inhibitor NCI8 at 1 μ M and 3 μ M concentrations. Knockdown of MELK with siRNA resulted in significant inhibition of cellular proliferation.

Conclusions: Maternal embryonic leucine zipper kinase enriches for tumor-initiating cells in human medulloblastomas and plays a key role in tumor proliferation in vitro. Further study of this kinase may lead to a better understanding of the tumorigenic process in medulloblastomas and could potentially lead to novel therapies.

52. The Human Neonatal Cerebrospinal Fluid Proteome: Application of Nano-LC-FT-MS Proteomics to Post-Hemorrhagic Hydrocephalus

David D. Limbrick, MD, PhD; Carrie Mercier, BS; Reid Townsend, MD, PhD; Terrie Inder, MD, PhD (St. Louis, MO)

Introduction: Proteomic analysis of cerebrospinal fluid (CSF) of human preterm infants has not previously been reported. Data derived from such analysis could provide critical information regarding conditions impacting neurodevelopment and play a key role in the identification of biomarkers of newborn neurological disorders such as post-hemorrhagic hydrocephalus.

Methods: CSF was collected from age-matched preterm infants under three different conditions: lumbar CSF in infants undergoing lumbar puncture (LP) for fever evaluations (where CSF cultures later proved to be sterile); ventricular CSF in infants with intraventricular hemorrhage (IVH); and ventricular CSF in infants with IVH and progressive post-hemorrhagic ventricular dilation (PHVD) requiring repeated CSF removal.

Results: CSF was collected from 3 infants in each group. The CSF was run through complementary immunoaffinity columns to extract high abundance proteins and enhance detection of low abundance proteins. The flow-through fraction was digested and analyzed using a nano-LC-FT-MS platform. Analysis of the flow-through fraction yielded > 200 individual proteins. Inter-group comparisons revealed differential expression of proteins (angiotensin II, Beta-2 microglobulin, AFP, others) in the PHVD group versus LP and IVH groups. Cluster analysis of serial CSF samples taken from 3 PHVD infants showed trends in the expression of such key proteins as neuromodulin, L1 CAM, and cystatin c, all of which are involved in neurodevelopment or neurological disease.

Conclusions: High-throughput proteomics is a promising technique for studying proteins involved in neurodevelopment and neurological disease. This technique may be useful in the development of low-abundance biomarkers of conditions such as post-hemorrhagic hydrocephalus.

53. The Role of a Gluteal Crease Abnormality in Predicting an Underlying Tethered Cord in Children

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Introduction: A gluteal crease abnormality is one of many cutaneous physical exam findings that may serve as an external marker for a tethered spinal cord. Although a deviated or duplicated gluteal crease is anecdotally included in a list of several possible findings, its predictive role for this type of dysraphism has not been formally assessed.

Methods: We performed a retrospective review from 2006 to 2008 of 864 patients referred for a possible tethered cord. To address the sensitivity of crease abnormality in detecting a tethered cord, we calculated the percentage of patients presenting with an abnormal crease who were later diagnosed with a tethering. A second review, aimed at specificity, looked at the percentage of cord release surgery patients who presented with an abnormal crease. Other skin findings were also tabulated.

Results: A total of 55 patients presented with an abnormal crease and 20 (36.4%) of these patients were diagnosed with a tethered

cord. 27 of 64 patients (42.2%) who underwent tethered cord release presented with some abnormality of the gluteal crease. All 5 patients presenting with duplicated creases were later found to have tethered cords. 40% of patients (22 of 55) presenting with abnormal creases possessed other skin findings.

Conclusion: An abnormal gluteal crease should be considered a valuable physical exam finding. Gluteal crease abnormalities are more predictive than suggested by anecdotal experience, perhaps more so with duplicated rather than simply deviated creases. This information will likely prove useful to the clinician deciding between imaging the spine or simply observing over time.

54. The Terminal Myelocystocele

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Introduction: The terminal myelocystocele is a rare closed spinal dysraphism that is a result of a disturbance in secondary neurulation; it can be associated with caudal regression anomalies.

Methods: We present a series of eight (8) patients with terminal myelocystoceles over a seven (7) year period (2001-2008). Operative repair technique is described and illustrated as well as the introduction of the "shuttlecock" (badminton birdie) sign as an anatomical prop.

Results: Three (3) infants had lipomyelocystoceles, and two (2) had associated complete caudal regression syndrome with bladder extrophy, omphalocele. The other three (3) had isolated terminal myelocystoceles. Repair time ranged from two (2) days of life to eight (8) months of life. Five (5) of the infants had associated Chiari malformations and one (1) of these had treated hydrocephalus. All patients postoperatively maintained their preoperative level of function, five (5) at L5/S1, one (1) at L4 and the two with complete caudal regression were paraplegic. Three (3) patients required secondary operations; Chiari decompression, tethered cord release, dehiscence repair and an Endoscopic Third Ventriculostomy (ETV). Bladder function was variable.

Conclusions: The terminal myelocystocele is a complex, closed spinal dysraphism; proper understanding of its anatomy is essential for repair and preservation of level of function.

55. Bipolar Versus Monopolar Coagulation of Occluding Tissue in Ventriculoperitoneal Shunts

Mustafa Q. Hameed, MD; Tomer Anor, PhD; Joseph R. Madsen, MD (Boston, MA)

Introduction: Ventriculoperitoneal shunts are a life-saving treatment for hydrocephalus patients, but shunt catheters commonly require replacement. Monopolar cautery (MC) is frequently employed to reduce the risk of intraventricular hemorrhage during revisions; however it is not always successful. We therefore seek a safer way to prevent bleeding during shunt revisions, by minimizing exposure of important structures to unregulated electrocautery.

Methods: Computer models of both techniques were implemented with the finite-element program COMSOL. Comparative testing was conducted by advancing a monopolar stylet or a bipolar coagulator into ventricular catheters placed in egg whites. Bipolar coagulation (BC) was also tested in catheters inserted into rat jejunum. Tissues were stained for NADPH diaphorase activity to visualize injury before histology.

Results: Finite element analysis predicted that energy delivery with BC remained confined to the region of the electrodes regardless of site of occlusion, while with MC the bulk of the energy was delivered to open intake holes proximal to the occlusion. Direct experimental data support the computational results. Egg-white coagulum remained confined to catheter holes with BC and was more widespread with MC (n=1 each at 3 settings per technique). Jejunal tissue showed discrete areas of injury at points corresponding to intake holes as the wand was advanced into the catheter. Maximal tissue damage was observed at the point where the coagulator made direct contact with the tissue (n=2 each at 4 settings).

Conclusion: Bipolar coagulation presents a safer means for removal of occluded ventricular catheters during shunt revision surgery, and a potential reduction in the frequency of such surgeries.

56. Predictors of Ventricular Shunt Infections in Children

Elisabeth Ashley, MD; Joseph R. Madsen, MD; Amir Kimia, MD; Lise E. Nigrovic, MD, MPH; Mark I. Neuman, MD, MPH (Boston, MA)

Introduction: Data regarding clinical predictors of ventricular shunt infection in children are limited.

Methods: Retrospective cohort study of children 3 months to 21 years of age evaluated in a single tertiary pediatric ED between 1995-2008 for possible ventricular shunt infection. All children had CSF obtained within 24 hours of presentation to the ED. A shunt infection was defined by growth of bacteria in the CSF in a child who underwent shunt removal or externalization due to concern of shunt infection. Multivariate logistic regression was performed to identify clinical predictors of ventricular shunt infection.

Results: 979 children with a ventricular shunt had CSF obtained; median age was 7.0 years. 130 (13%) patients had growth of bacteria in CSF; organisms most commonly isolated included *Staphylococcus non-aureus* (n=23) and *Staphylococcus aureus* (n=11). 55 patients (5.6%) met our definition of shunt infection. The median time since last shunt revision or placement was shorter for patients with a shunt infection compared to children without shunt infection (47 days vs. 207 days, p = 0.001). After adjustment for patient age, three factors were associated with shunt infection: history of fever (aOR=10.4, 95% CI =5.6-19.5), erythema overlying the shunt (aOR=3.7, 95% CI=1.0-13.5) and shunt revision within the prior 3 months (aOR=2.9, 95% CI=1.6-5.3).

Conclusions: Among children with a ventricular shunt who have CSF obtained in the ED, 5.6 % have a shunt infection. The presence of fever, erythema overlying the shunt and recent shunt revision are associated with an increased risk of shunt infection.

ORAL ABSTRACTS

57. VEGF-Induced Ventriculomegaly and Neutralizing Angiogenesis

Joon W. Shim, PhD; Johanna Sandlund, MD, PhD; Carin H. Han; Mustafa Q. Hameed, MD; Michael Klagsbrun, PhD; Joseph R. Madsen, MD (Boston, MA)

Introduction: Vascular endothelial growth factor (VEGF) is an angiogenic and permeability-inducing factor. Elevated levels of VEGF or its receptor (VEGFR2) have been associated with experimental and human hydrocephalus (HC), and we hypothesize that it may have a causal relationship with this neurological condition.

Methods: To explore a possible contributory role of VEGF in HC in an animal model without obstruction of CSF pathways, mini-osmotic pumps for intraventricular infusion of VEGF-A were implemented to assess the impact of VEGF on ventricular size and function, and to test the efficacy of inhibitors for VEGF-A (bevacizumab) and VEGFR2 (semaxanib).

Results: Regulated infusions of VEGF-A165 for 7 d via osmotic pumps into the rat brain revealed that VEGF-A165 induced ventriculomegaly, angiogenesis, and hyperpermeability in the periventricular region. Expression of VEGFR2, one of the receptors for VEGF, was limited to choroid plexus and ependyma in the sham-operated control. In contrast, exuberant VEGFR2 immunoreactivity was visible from ependyma towards subependyma and septum in the VEGF-induced ventriculomegaly. Inhibition of VEGF-A by bevacizumab or endogenous VEGFR2 by semaxanib was sufficient for the recovery of blood brain barrier exhibited by intravenous injection of Evans blue. Simultaneous delivery of VEGF-A165 and bevacizumab did not result in ventriculomegaly.

Conclusions: This laboratory work indicates that VEGF-A165 was responsible for the development of ventriculomegaly in our experiment. VEGF might play a role in the pathophysiology of human HC and neutralizing its action by angiogenesis inhibitors, especially for HC with high CSF VEGF or hyperpermeability in the central nervous system, may be a potential therapeutic approach.

58. Comparison of Ventricular Reservoirs and Ventriculosubgaleal Shunts in the Management of Post-Hemorrhagic Hydrocephalus

James M. Johnston, MD; Matthew D. Smyth, MD; James Sagar, MD; Tae Sung S. Park, MD; Jeffrey R. Leonard, MD; Rebecca Munro, MA; David Limbrick, MD, PhD (St. Louis, MO)

Introduction: Intraventricular hemorrhage (IVH) commonly results in post-hemorrhagic ventricular dilation (PHVD) and hydrocephalus in preterm infants. Despite the relative frequency of PHVD and its predilection for shunt-dependence and poor neurodevelopmental outcome, there is no consensus regarding the optimal neurosurgical treatment for PHVD. Questions remain about the relative benefits of the use of ventricular access devices (VADs) versus ventriculosubgaleal shunts (VSGSs) in the management of PHVD.

Methods: This is a single center, ten year retrospective review of 341 preterm infants with Papile Grade III-IV IVH, of which 102 developed PHVD. 72 underwent implantation of VADs and 30 received VSGSs. Relative rates of permanent shunt implantation, perioperative complications, infection and mortality were determined and statistically compared.

Results: Data analysis shows an increase in the number of infants with severe IVH as well as the number requiring neurosurgical intervention over the ten year time period. The rate of shunt dependence for all cases of PHVD was 74.2%, with no statistical difference between VAD or VSGS (77.8% vs 72.4%, $p = 0.83$). No difference in mortality, postoperative complications, or infection rate was observed between the two groups.

Conclusions: The increase in number of children with surgically-

managed IVH seen at our center may be due to increased survival of prematurely born infants and/or regionalization of neonatal care. In our experience, and in contrast to recent literature, there does not appear to be any significant difference in shunt dependence or complication rate between VADs and VSGSs. Definitive conclusions will require a larger, prospective trial.

59. Shunt Survival Following Surgical Release of Tethered Spinal Cord

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Introduction: Those patients with shunted hydrocephalus undergoing surgical release of a tethered cord are thought to be at particular risk for postoperative shunt malfunction. The association between shunt survival and tethered cord release is sparse, has not been reported in detail, and a large data set has yet to be presented. We reviewed a series of pediatric patients with shunted hydrocephalus undergoing cord untethering to assess shunt survival and determine independent risk factors associated with failure.

Methods: We retrospectively reviewed a consecutive series of pediatric patients who underwent tethered cord release from 1996 - 2006.

Results: Of 115 pediatric patients who underwent tethered cord release, we identified 24 patients with shunted hydrocephalus undergoing 43 procedures for cord untethering, including primary and revision operations. After 43 cases, there were 10 (23.3%) shunt malfunctions within one year: 1 (2.3%) occurring within one month, 7 (16.3%) from one to six months, and 2 (4.7%) from six to twelve months. Malfunctions included 7 proximal and 3 distal. Mean time to failure following cord untethering was 135.2 days. Independent variables including prior number of shunt revisions, blood loss, method of dural closure, and presence of CSF leak or pseudomeningocele did not demonstrate statistically significant associations. There was a trend for shorter time to malfunction in older children.

Conclusions: Our series, the largest to date, indicates that tethered cord release in patients with shunted hydrocephalus confers a definitive risk for shunt malfunction, especially within the immediate six-month postoperative period. This study warrants further investigation into methods to reduce postoperative shunt malfunction.

60. Fourth Ventricular Shunt Survival Comparing Stereotactic Transtentorial and Suboccipital Approaches

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Introduction: Standard management of localized fourth ventricular hydrocephalus consists of placement of a suboccipital fourth ventricular shunt (FVS). Alternatively, a stereotactically guided transtentorial approach to the fourth ventricle can be used. In this report, we compare shunt survival and revision rates after these alternate approaches.

Methods: We retrospectively reviewed 21 consecutive patients who underwent FVS placement from 1998 to 2009 either via a suboccipital burr hole or via the stereotactic transtentorial approach through a burr hole placed in a supratentorial position. Only patients whose surgeries involved placement of first-time shunts from the specified approach were included. Shunt survival, defined as time to first shunt failure, was analyzed.

Results: Groups A (suboccipital approach) and B (stereotactic transtentorial approach) had 12 and 9 patients, respectively. The revision rate was 83% (10 patients) for group A and 56% (5 patients) for group B. The average shunt survival was 165 days in group A and 651 days in group B ($P < 0.001$). Group A included 3

patients (25%) who crossed over from failed stereotactic transtentorial FVS, while group B had 8 patients (89%) who crossed over from failed suboccipital FVS.

Conclusions: Stereotactically guided transtentorial FVS resulted in significantly longer shunt survival times and lower rates of revision than the traditional suboccipital approach, despite a higher rate of crossover from previously failed shunting procedures. Stereotactic transtentorial shunt placement may be considered for patients with loculated fourth ventricular hydrocephalus, especially when shunt placement via the standard suboccipital approach fails.

61. Intraoperative Assessment of Cerebral Aqueduct Patency and Cisternal Scarring: Impact on Success of Endoscopic Third Ventriculostomy in 403 African Children

Benjamin C. Warf, MD (Boston, MA); Abhaya V. Kulkarni, MD, PhD (Toronto, Canada)

Introduction: We wished to determine whether cisternal scarring or aqueduct patency observed at surgery were sufficiently predictive of endoscopic third ventriculostomy (ETV) failure to justify shunt placement at the initial operation.

Methods: The status of the pre-pontine cistern and aqueduct observed at the time of ventriculoscopy was prospectively recorded in 403 children in whom an ETV was completed. Kaplan-Meier methods were used to construct survival curves. A Cox proportional hazards model was used to provide estimates of hazard ratios for time-to-ETV failure. We tested several independent variables in a single multivariable model, including variables previously shown to be associated with ETV survival in addition to the aqueduct (closed versus open) and the pre-pontine cistern (scarred versus not scarred).

Results: Multicollinearity was not found to be of concern (variance inflation factors for all variables < 2). Examination of stratified survival curves confirmed the appropriateness of the proportional hazards assumption for each variable. Overall actuarial 3-year success was 57%. Consistent with previous results, age, etiology of hydrocephalus and extent of choroid plexus cauterization were significantly associated with ETV survival. A closed aqueduct and a non-scarred cistern were each independently associated with significantly better ETV survival (hazard ratios of 0.66 and 0.44, respectively). The presence of cisternal scarring more than doubled the risk of ETV failure and an open aqueduct increased the risk of failure by 50%.

Conclusions: Intraoperative observations of the aqueduct and the pre-pontine cistern are independent predictors of failure risk and can be used to further refine outcome predictions.

62. Ventriculo-Subgaleal Shunting: A Strategy to Reduce the Incidence of Slit Ventricles and Shunt Revisions

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Introduction: Slit ventricles and multiple episodes of shunt failure are problematic in many infants and preterm neonates shunted for hydrocephalus. We utilized a strategy of performing a ventriculo-subgaleal (VSG) shunt as the initial neurosurgical intervention in neonates with hydrocephalus secondary to intraventricular hemorrhage and infants with hydrocephalus associated with myelomeningocele. A discussion of the rationale for taking this approach will be reviewed.

Methods: The authors reviewed 21 children initially treated with a VSG shunt between November 2002 and July 2009.

Results: There were 9 cases of radiographic slit ventricles (43%). Average follow-up was 51.1 months (range 12-88 months). Five of seventeen patients required shunt revisions (29.4%). Average number of shunt revisions following conversion to a ventriculo-peritoneal shunt (VPS) was 0.53 (9 VPS revisions total; range 1-4). Average time interval to shunt conversion (VSG-VPS) was 80.3 days. One patient has not required conversion to a VPS (7 year follow up). There were 2 VSG shunt infections. We will also discuss other variables such as age, shunt types, and frontal-occipital horn ratio. To date, none of the patients have required a subtemporal window or cranial vault expansion.

Conclusions: The reported incidence of post-shunt slit ventricles is greater than 90% in premature neonates and 85% in neonates. Based on our results, initial management of select hydrocephalic infants with a VSG shunt may prove to be advantageous in the long run for these children, as the incidence of slit ventricles and the number of shunt revisions is significantly less than that reported in the literature.

63. Quality of Life in Obstructive Hydrocephalus: Endoscopic Third Ventriculostomy Compared to Cerebrospinal Fluid Shunt

Abhaya V. Kulkarni, MD, PhD; Sonya Hui, BSC; Iffat Shams, MSc; Ruth Donnelly, PhD (Toronto, Canada)

Introduction: In the current literature, there are essentially no comparisons of quality of life (QOL) after ETV versus CSF shunt in children with hydrocephalus. Our objective was to compare QOL in children with obstructive hydrocephalus, treated with either ETV or shunt.

Methods: The strict inclusion criteria for this cross-sectional study were: 5-18 years old with hydrocephalus due to aqueduct obstruction and no other brain abnormalities. Measures of QOL were the Hydrocephalus Outcome Questionnaire (HOQ) and the Health Utilities Index Mark 3 (HUI-3). A subset of patients was given the Wechsler Intelligence Scales for Children (WISC-IV).

Results: A total of 47 of 59 (80%) eligible patients participated (24 ETV, 23 shunt), with a mean age of 12.1 years (SD 3.9) at assessment and 9.0 years (SD 4.6) since initial hydrocephalus treatment. The ETV group was older at diagnosis ($p < 0.001$) and had larger ventricle size at last follow-up ($p = 0.047$). There was no difference in all QOL measures between ETV and shunt (all $p = 0.09$). Treatment failure, hydrocephalus complications, and the presence of a functioning ETV at assessment were not associated with QOL differences. Among the 11 children (6 ETV, 5 shunt) who were given the WISC-IV, the differences were also not significant (all $p = 0.11$).

Conclusions: This is first study to provide a meaningful comparison of QOL after ETV and shunt. The results are preliminary, but suggest that there are no obvious QOL differences. Further studies are needed in larger samples of patients.

ORAL ABSTRACTS

64. DTI Findings in Children with Benign External Hydrocephalus

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Introduction: Benign external hydrocephalus (BEH) is a self-limited condition of infancy and early childhood characterized by macrocrania and enlarged subarachnoid space. Diffusion tensor imaging (DTI) findings in children with BEH have not been previously described.

Methods: 13 children (5.49-40.93 months) with BEH and MRI/DTI scans were analyzed and compared with age-matched control group (5.75-40.73 months, age difference=0.36±0.28m). DTI parameters were calculated in the genu and splenium of the corpus callosum (gCC, sCC) and in the anterior and posterior limbs of the internal capsule (ALIC, PLIC). Data was compared to age-matched controls and plotted onto fitted fractional anisotropy (FA) curves containing 99% prediction intervals generated from our control database of normative DTI values (n=256).

Results: 2/12, 5/13, 5/12, 5/13 had fractional anisotropy (FA) higher than upper limits of 99% prediction intervals for gCC, sCC, ALIC, and PLIC, respectively. FA values were significantly higher in BEH patients than that in the age matched controls in sCC (0.78±0.06 vs. 0.73±0.05, paired t-test, p=0.02) and the ALIC (0.57±0.07 vs. 0.52±0.05, p=0.04). No significant FA difference was found in either gCC or PLIC. There was no significant difference noted in mean diffusivity.

Conclusions: These findings demonstrate that the majority of children with BEH have DTI findings that fit within normative FA curves for age. However, comparison of FA values in BEH patients to age-matched controls demonstrated significant increases in the sCC and ALIC. Increased directionality of water diffusion in these regions may indicate subclinical changes of these white matter tracts in children with BEH.

65. Re-Infection Following Initial Cerebrospinal Fluid (CSF) Shunt Infection

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Introduction: Significant variation exists in both surgical and medical treatment of CSF shunt infection. Only small studies have been performed. Objectives were: 1. Determine cerebrospinal fluid (CSF) shunt re-infection rates following initial CSF shunt infection in a large cohort. 2. Determine management, patient, hospital, and surgeon factors associated with CSF shunt re-infection.

Methods: This retrospective cohort study included children age 0-18 years who underwent uncomplicated CSF shunt placement and treatment for first CSF shunt infection in the Pediatric Health Information System (PHIS) database. The outcome was re-infection within 6 months. Surgical approach to treatment of infection was determined for 483 patients.

Results: PHIS contains 675 children with first CSF shunt infection. The 6 month re-infection rate was 14.8% (100/675). Several children (11.0%, 74/675) were treated by complete shunt removal, and children who were treated non-surgically had significant re-infection (23.4%, 15/64). Re-infection did not differ between the two most common surgical approaches [externalization (16.7%, 7/42) and shunt removal/replacement (15.4%, 44/286)]. Failed externalization had a high re-infection rate (29.4%, 5/17). No differences were seen in other management factors (duration of intravenous antibiotic use); patient factors (patient age at either shunt placement or first infection, gender, race/ethnicity, payer,

indication for shunt, number of co-morbidities, distal shunt location, number of shunt revisions at first infection); hospital volume; or surgeon volume. Those with re-infection had less time from shunt placement to initial infection (median 50 vs. 79 days, p=0.06).

Conclusions: Surgical approach to treatment of initial infection was not associated with re-infection in this large cohort of patients.

66. Transnasal Odontoidectomy Followed by Posterior Decompression and Occipitocervical Fusion in Children with Chiari I Malformation and Ventral Brainstem Compression

Richard C. Anderson, MD; Todd C. Hankinson, MD; Eli Grunstein, MD (New York, NY); Paul Gardner, MD; TJ Spinks, MD (Pittsburg, PA)

Introduction: In rare cases, children with Chiari I Malformations (CMI) suffer from concomitant ventral brain stem compression that may result in cranial neuropathies or brain stem dysfunction. In these circumstances, a 360o decompression supplemented by posterior stabilization and fusion is required. In this report, we present the first experience using an endoscopic transnasal corridor to accomplish ventral decompression in children with CMI complicated by ventral brainstem compression.

Methods: Two children presented with occipital headaches, swallowing dysfunction, myelopathy, and progressive scoliosis. Imaging studies demonstrated CMI with severely retroflexed odontoid processes and ventral brainstem compression. Both patients underwent an endoscopic transnasal approach for ventral decompression, followed by posterior decompression, expansive duraplasty, and occipital-cervical fusion.

Results: In both patients the endoscopic transnasal approach provided excellent ventral access to decompress the brainstem. When compared with the transoral approach, endoscopic transnasal access presents four potential advantages: (1) excellent prevertebral exposure in patients with small oral cavities, (2) a surgical corridor located above the hard palate to decompress superiorly located pathology more easily, (3) avoidance of the oral trauma and edema that follows oral retractor placement, and (4) avoidance of splitting the soft or hard palate in patients with oral-palatal dysfunction from ventral brainstem compression.

Conclusions: The endoscopic transnasal approach is less traumatic to the oral cavity and offers a more superior region of exposure when compared with the standard transoral approach. Given their comfort level using endoscopic surgical techniques, pediatric neurosurgeons should consider this approach in children with pathology requiring ventral brainstem decompression.

67. Pus and Free Bone Flaps

Lars Widdel, MD; Ken Winston, MD (Aurora, CO)

Introduction: The common practice for contaminated free bone flaps consists of discarding the flap, administering a course of antibiotics and, after several months, cranioplasty. We describe the technique and results of a vigorous attempt to preserve infected cranial bone flaps.

Methods: All patients with avascular bone flaps that were clearly in contact with purulence were included. The patients were treated by meticulous debridement of the surgical bed, debridement and scrubbing of the flap, soaking in iodophor solution and then immediately returning the bone flap to its normal position. All

patients received a course of intravenous antibiotics

Results: Fourteen patients, ages 3 months to 28 years, with contaminated avascular cranial bone flaps mainly due to post-craniotomy infections or subdural empyema were managed by this technique. The series included patients who had high risk due to prior radiation therapy, those with nasal sinus involvement, patients who had a recent period of percutaneously coursing electrode wires, and patients with a history of multiple recent cranial operations. All 14 contaminated bone flaps were successfully preserved.

Conclusions: Patients with bacteriologically contaminated, free bone flaps can be managed successfully without discarding the bone flaps. Success is dependent upon aggressive surgical debridement and persistence.

68. Preoperative Motor Mapping with Resting State Functional Connectivity Magnetic Resonance Imaging

James M. Johnston, MD; Carolyn E. Pizoli, MD, PhD; Joshua Shimony, MD, PhD; David D. Limbrick, MD, PhD; Matthew D. Smyth, MD (St. Louis, MO)

Introduction: Slow (<0.1Hz), spontaneous fluctuations in the functional magnetic resonance imaging blood oxygen level-dependent (BOLD) signal have been shown to be coherent within functionally related areas of the brain. Resting functional connectivity MRI (fcMRI) correlates these fluctuations across cortex to identify discrete brain networks, including somatomotor, attention, language, memory, and vision. We present our preliminary experience with fcMRI for motor mapping in pediatric epilepsy surgery.

Methods: Five children undergoing evaluation and surgery for refractory epilepsy were enrolled and prospectively evaluated in this study. All obtained standard preoperative MRI in addition to a resting functional connectivity BOLD sequence. Processing of functional data allowed prediction of motor cortex location, with volumetric statistical results projected onto anatomic images. All children then underwent craniotomy with placement of subdural electrodes, intraoperative cortical mapping and/or extraoperative grid stimulation mapping. Motor cortex location predicted by resting fcMRI was then compared to gold standard stimulation mapping.

Results: Preliminary data analysis suggests that fcMRI-predicted location of motor cortex correlates well with the gold standard of intra or extraoperative cortical stimulation mapping.

Conclusions: Resting state fcMRI represents a powerful functional imaging technique of particular value in pediatric neurosurgery, as it requires no active participation and is present even under general anesthesia. Image acquisition and post-processing protocols that allow integration with standard neuronavigation software are in development that will standardize the technique, making it useful for preoperative evaluation in both epilepsy and tumor surgery.

69. The Efficacy and Safety of Occipital Screw Placement for Occipitocervical Fusion in Children

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Introduction: Occipitocervical stabilization in the pediatric age group remains a challenge. Because of the regional anatomy, poor occipital bone purchase, and in some instances, significant thinning

of the occipital bone, multiple bicortical fixation points to the occipital bone may be required to increase construct rigidity. There have been no series of children evaluating the efficacy and safety of bicortical occipital screw placement.

Methods: A retrospective review of 9 consecutive pediatric patients who underwent occipitocervical fusion from September 1st, 2007 to March 30th, 2009 at Texas Children's Hospital was performed.

Results: Five girls and 4 boys ranging in age from 10 months to 16 years (mean, 9 years) were treated. All patients reached at least 3-month follow-up (mean, 11 month; range 3-20 months) with evaluation by dynamic x-rays and CT. There were 2 cases of intraoperative dural venous sinus injury, and 2 cases of intraoperative CSF leak; there were no clinical sequelae from these complications. No hardware failure, pseudoarthrosis, or loss of correction was identified clinically or radiographically at 3 months and latest follow-up. There were no difficulties with wound healing from prominent occipital instrumentation.

Conclusions: This report confirms that including bicortical occipital screws in an occipitocervical construct result in a durable, stable fusion even in the youngest of patients; however, the intraoperative complication rate from occipital screw placement is significant.

70. Minimally Invasive Placement of Pedicle Screws in Adolescent Patients Using a Neuronavigation Platform

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Introduction: Posterior spinal fusion is a standard treatment for thoracolumbar fractures. Modern imaging and guidance systems have recently begun to be employed in the placement of spinal hardware although their use has not been extensively described in pediatric patients.

Methods: A group of adolescent trauma patients underwent placement of posterior thoracolumbar pedicle screws using a minimally invasive system with the assistance of a neuronavigation platform.

Results: Three patients ages 13, 16, and 16 underwent posterior fusion for stabilization of thoracolumbar fractures. After positioning the patient in a Jackson table, the patients had intra-operative imaging three-dimensional images obtained with an O-arm imaging system. These images were then interfaced with a Stealth Station navigation system. The screws were then navigated into the vertebral body using minimally invasive systems. Post-placement imaging was then performed to confirm the placement prior to leaving the operating room. A total of 14 screws were placed in 3 patients. There were no cases of misplacement of hardware and no hardware failures occurred. No patients had evidence of hardware fusion and none developed a deformity.

Conclusions: Neuronavigation and intra-operative imaging systems can be useful adjuncts in the surgical treatment of thoracolumbar trauma. These systems are particularly useful when employing minimally invasive fusion systems.

ORAL ABSTRACTS

71. Use of Suboccipital Autograft in Pediatric Cervical Spine Fusion

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Introduction: Posterior cervical fixation is an important technique in the field of pediatric neurosurgery. Frequently, instrumented fusion is augmented with autograft from iliac crest or rib. As an alternative, we have begun to routinely use suboccipital bone as autograft for augmenting cervical fixation.

Methods: Eight patients underwent posterior or anterior/posterior cervical spine surgery with rigid instrumentation and suboccipital autograft within the past two years. The technique requires extension of the upper cervical incision past the external occipital protuberance. After segmental instrumentation, burr holes are created over the lateral suboccipital bone inferior to theinion. The craniotome is used to create bilateral craniotomies between 2-2.5 cm. A minimum of 1-cm of bone is left in the midline keel for occipital plating. Harvested bone can be used as struts or morselized. Demineralized bone matrix strips are placed in the suboccipital defects and over the autograft. The patient is typically placed in a collar postoperatively.

Results: The median age at surgery was 12.5 years (range 1-19 years). Surgical indications included trauma, tumor, and progressive post-laminectomy deformity. Average length of follow-up was 6.7 months (range 1-18 months). Constructs ranged from 2 to 4 levels. Solid fusion was demonstrated in all patients with CT follow-up greater than 3 months (n=5). No patient had evidence of pseudoarthrosis, or morbidity from the autograft harvest site.

Conclusions: Suboccipital autograft can be a safe and effective technique to augment posterior cervical spine fusion in the pediatric population. This technique may be a simpler and safer alternative to traditional methods.

72. Intraoperative Monitoring of Motor-Evoked Potentials in Very Young Children Less Than 3 Years of Age

Andrew H. Jea, MD; Krishna B. Satyan, MD; Lillian M. Wilder; James J. Riviello, MD; Stephen A. Stayer, MD; William E. Whitehead, MD; Daniel J. Curry, MD; Robert C. Dauser, MD; Thomas G. Luerssen, MD (Houston, TX)

Introduction: Monitoring of MEPs is advocated during spinal surgery, but clinical data from children are sparse. The purpose of this study was to determine the reliability and safety of MEP monitoring in a group of children less than 3 years of age undergoing neurosurgical procedures.

Methods: A total of 6 consecutive procedures in 6 children less than 3 years of age were analyzed from January 1, 2008 to December 31, 2008 out of a pool of 66 pediatric patients undergoing MEP monitoring. MEPs were elicited by TES. A standard anesthesia regimen was used consisting of a titrated propofol drip, and fentanyl or sufentanil boluses.

Results: Robust MEPs at the beginning and end of the procedure were documented in all 6 patients. A mean baseline stimulation threshold of 551 V (range, 321 - 746 V) was used. MEP signals greater or equal to 50% of baseline amplitude throughout the entirety of the surgery were maintained in 3 of 6 children. In 3 patients, there was a greater than 50% decrease in intraoperative MEP amplitude in at least one extremity; in one instance though, this decrement in MEP persisted at the end of the procedure and corresponded to postoperative weakness. There were no complications related to the technique of monitoring MEPs.

Conclusions: A TES protocol monitoring corticospinal motor pathways during neurosurgical procedures in children less than 3 years of age could be reliably and safely implemented without significant adjustments in stimulation methods or anesthetic regimens.

73. Intracranial Hemorrhage and Neurosurgical Intervention during Extracorporeal Membrane Oxygenation

Shawn L. Hervey-Jumper, MD; Andrea Yancon, BS; Gail Annich, MD, MS; Hugh J L Garton, MD, MHSc; Karin M. Muraszko, MD; Cormac O. Maher, MD (Ann Arbor, MI)

Introduction: Extracorporeal Membrane Oxygenation (ECMO) is associated with a risk of intracranial hemorrhage. The goal of this study is to identify the incidence of intracranial hemorrhage in patients on ECMO as well as define treatment outcomes.

Methods: A consecutive, single-institution case series of ECMO between 1983 and July 2009 was reviewed for incidence, location and severity of intracranial hemorrhage, medical and surgical management, survival and neurologic outcomes.

Results: Over a 25 year interval, 1,898 consecutive patients have been treated with ECMO at our institution. 1,225 (65%) of these patients survived to hospital discharge or transfer to another facility. 76 of 1347 (5.6%) of children (<16 years of age) had intracranial hemorrhage complications diagnosed by ultrasound or head CT compared to 9 of 430 (2%) adults (p= 0.003). The majority of intracranial hemorrhage complications on ECMO occurred in neonates less than 30 days of age with a 6.3% (60 of 949) incidence compared to 4.0% (16 of 398) of pediatric ECMO patients older than 30 days. 3 patients underwent craniotomy for evacuation of the hemorrhage. Two were taken to the operating room while cannulated. One patient was decannulated with anticoagulation reversed prior to the craniotomy. Two of the three patients are alive without significant neurological deficits.

Conclusions: Intracranial hemorrhage is a serious complication of the systemic anticoagulation required for ECMO. While the surgical risk is substantial, craniotomy may be indicated in well-selected patients.

74. Pial Synangiosis in Patients with Moyamoya Under Two Years Old

Eric M. Jackson, MD; R. Michael Scott, MD; Edward R. Smith, MD (Boston, MA)

Introduction: Moyamoya patients under two years old represent a therapeutic challenge because of their frequent neurologic instability and concomitant anesthetic risks. We report our experience with pial synangiosis revascularization in this population.

Methods: Retrospective chart review.

Results: During a 12 year period (1994-2005), thirty-four procedures (15 bilateral, 4 unilateral) were performed in 19 patients under two years of age (out of a total of 456 procedures in 240 patients). Eighteen of these patients presented with either stroke or TIA. Average age at first surgery was 1.4 years (range 0.5 - 1.9). Unanticipated staged operations occurred in three patients, two due to persistent EEG changes during the initial surgery and one due to brain swelling during the procedure requiring ventriculostomy. There were two perioperative strokes; both patients had post-operative seizures but made clinical recoveries. The average follow-up was 7 years (range 1-14). Late complications included subdural hygroma evacuation (1), additional revascularization procedures years later for frontal lobe ischemia (2), late infarction (1) and asymptomatic ischemic change on routine follow-up MRI studies (1).

Conclusions: Despite the challenges inherent to this population, the majority of children with moyamoya under the age of 2 years have a good long-term prognosis. Our data support the use of pial synangiosis as a safe, effective and durable method for treatment of moyamoya for most children in this potentially high-risk population.

75. Sacroiliac Joint Pain in Pediatric Patients

Jeffrey Leonard, MD (St Louis, MO); Rebecca Munro, MA; Alex Powers, MD (Winston-Salem, NC); Joan Puglisi, PT (St. Louis, MO)

Introduction: Sacroiliac joint (SIJ) pain is a well recognized cause of persistent low back pain (LBP) in adults. Although low back pain is not as common in pediatric patients, it is a common indication for referral to a pediatric neurosurgeon. Distinguishing between SI joint pain and intervertebral disk pathology is crucial in making the appropriate diagnosis and avoiding unnecessary surgery. This study seeks to better understand the clinical indicators of SI joint pain in pediatric patients that present to a pediatric neurosurgeon with the chief complaint of LBP.

Methods: 34 patients, seen by the senior author between April 2004-2009, were identified with the chief complaint of "low back pain" and their charts were reviewed for basic demographic information, symptoms, imaging results, physical exam findings, and history of treatment.

Results: 34 patients (11 male, 23 female), average age 14.9 years, presented to a single pediatric neurosurgeon's clinic over 5 years with a chief complaint of LBP that persisted for an average of 7.3 months prior to referral. 16 patients were diagnosed with LBP secondary to SIJ pathology and underwent physical therapy manipulation. 10 patients (63%) reported complete resolution of their pain following a single treatment.

Conclusions: To our knowledge, this is the first report of pediatric patients presenting with SIJ pain. This series has several interesting findings, including a high rate of success with physical manipulation as the only treatment modality, a female to male ratio of 2:1, and an average of age that typically corresponds with the end of the adolescent growth spurt for females.

76. Disruption of Essential Neurodevelopmental Cytokine Networks is Exacerbated by Combined Prenatal Inflammatory and Hypoxic-Ischemic Injury

Shenandoah Robinson, MD; Obehi Irumudomon, BA; Qing Li, MD (Cleveland, OH)

Introduction: Perinatal brain injury frequently involves combined infection and hypoxia-ischemia, and causes neurological deficits including epilepsy and cerebral palsy. Balanced cytokine networks that regulate developmental processes are susceptible to insults. Erythropoietin (EPO) neuroprotection requires tumor-necrosis-factor-alpha (TNFα) receptors, but excess TNFα signaling is detrimental.

Methods: A rat model of simultaneous transient uterine artery occlusion and intracervical lipopolysaccharide (HI-LPS) on embryonic-day 18 was used to mimic human late-gestation insults. Molecular, cellular and functional analyses were performed and compared to sham controls, and HI-only. Statistical comparisons were performed using two-way ANOVA with P-value less than 0.05 considered significant.

Results: Newborn mortality was higher for pups with HI-LPS. Neonatal systemic recombinant EPO-treatment (rEPO) (postnatal day 1-3) restored HI-LPS pup survival to 100percent at postnatal day 3 (P3), compared to 40percent for saline-treated pups. Embryonic-day 19 EPO mRNA levels were lower in HI-LPS brains, compared to HI-only and shams. These results suggest that the combined injury alters EPO signaling, and that rEPO can mitigate the damage. Serum P3 TNFα levels increased 5.4-fold with HI-LPS compared to control levels, while HI-only induced a 2.5-fold increase. Neonatal rEPO reduced TNFα levels back to near-normal in HI-LPS pups, and to normal in HI-only pups. HI-LPS juvenile rats

performed worse on bar-testing (6.0sec) compared to HI-only (8.8) and controls (12.7). Additional studies regarding EPO/TNF interactions will be presented.

Conclusions: Cytokine networks are exquisitely balanced, and their disruption can cause permanent damage to the developing brain. Insights from this study will elucidate the avenues for safe use of biological interventions.

77. Survival of Adjustable Valve Shunts and Set-Pressure Valve Shunts in Children with Hydrocephalus

Krzysztof R. Drzymalski, BA; Meshkan Moghimi, BA; Nikki Thuijs, BA; Joseph Madsen, MD (Boston, MA)

Introduction: Adjustable valve shunts have been available for treatment of pediatric hydrocephalus for more than a decade. Prior to the development of these valves, only set-pressure devices were available for surgical treatment of hydrocephalus. McGirt et al (2005) suggested that adjustable pressure valves provide longer survival than set-pressure valves in proximal shunt obstruction while Kestle et al (2000) suggested that neither valve provides better survival as an initial shunt placement. Our study retrospectively examined for difference of shunt survival based on valve type over a twelve year time period at one pediatric hospital.

Methods: A database of children undergoing shunt placement for hydrocephalus was compiled from medical records followed continuously at one hospital between January 1996 and September 2008. Patients lost to follow-up were excluded from this study. Kaplan-Meier survival curves were generated to determine revision-free survival of adjustable valve shunts versus set-pressure valve shunts.

Results: A total of 186 children underwent 736 procedures (186 initial shunt placements and 550 revisions). The mean age at first shunt placement was 3.5 years (range 0-17.6 years). The median revision-free survival of adjustable valve shunts was 1.49 years (range 0-10.64 years) as compared to the median survival of set-pressure shunts of 0.534 years (range 0-12.5 years) (P=0.021). The survival curves overall were also significantly different (p<.05).

Conclusion: Adjustable pressure valve shunts yielded better long-term survival as compared to set-pressure valve shunts, though the actual role of adjustability is uncertain. Etiology of hydrocephalus, patient selection, and other factors require further study.

ORAL ABSTRACTS

78. Immortalization and Functional Characterization of Rat Arachnoid Cells

Christopher Janson, MD (Minneapolis, MN)

Introduction: Modeling the behavior of mammalian arachnoid cells is critical to understanding the physiology of hydrocephalus, yet little is known about transport properties of arachnoid cells due to lack of a robust three-dimensional model system. The purpose of this study was to create immortalized rat arachnoid cell lines to permit in vitro study of arachnoid granulations and properties of CSF flow.

Methods: The immortalization strategy we chose was based on retroviral transduction of explanted primary rat arachnoid cells with SV40 large T antigen (LTAg), either with or without human telomerase reverse transcriptase (hTERT). To quantify hTERT transduction, we performed a TRAP assay in non-transduced, single-transduced, and double-transduced cells. To determine that the cells were arachnoid cells and maintained their morphology before and after viral transduction, we tested a panel of immunohistochemical markers previously shown to define the arachnoid cell phenotype. Functional assays included doubling time measurements, transport in 2D culture with radiolabeled 3H mannitol, and transcellular resistance. Seeding density was assessed with electron microscopy in collagen matrices.

Results: Viral RNA genomic titers $>2 \times 10^9/\text{ml}$ were verified with qRT-PCR and transduction confirmed using immunohistochemical staining to LTAg and hTERT. Cell lines showed expected high-level expression of cytokeratin and vimentin intermediate filaments at early and late passages, and also demonstrated expression of desmosomes. Functional assays remained robust over >75 cell doublings.

Conclusion: The ultimate goal is the creation of a bioartificial shunt using patient-derived cells on a rigid scaffold, which could replicate properties of normal arachnoid cells and obviate the need for CSF shunting in hydrocephalus.

79. Lysis of Abdominal Adhesions for Distal Catheter Placement in the Difficult to Shunt Patient

Daniel K. Harmon, MD; Chevis Shannon; Reed Gavin; Shane Tubbs, PhD; Kurt Rozzelle, MD; Jeffery Blount, MD; W. Jerry Oakes, MD; Jay Wellons, MD (Birmingham, AL)

Introduction: The treatment of hydrocephalus remains a vexing problem in a subpopulation of patients that are difficult to shunt definitively due to peritoneal insufficiency. In those patients in whom the abdominal cavity had failed and no other standard distal site was available or deemed difficult due to known intraabdominal pathology, we consulted the general surgery service to perform surgical lysis of adhesions either as a separate procedure or at the time of shunt placement.

Methods: Combined general surgery and neurosurgery ventriculoperitoneal shunt placement cases were identified in the electronic medical records from 2005 thru 2009. Patients were included if general surgery assistance was required for peritoneal catheter placement due to previous multiple distal failures, multiple abdominal surgeries, or planned lysis of adhesions. Time to failure, type of failure, complications of surgery, severity of adhesions, and current shunt status were recorded. Intraabdominal adhesions were categorized as mild, moderate, or severe.

Results: 23 patients were identified. 16 (69.5%) required shunt revision due to failure or infection after surgical lysis of adhesions. The average time to failure was 78.3 days. However, 12 (52.2%) patients ultimately had successful peritoneal catheter function after revision. Those patients with severe adhesions had the poorest response to surgical lysis and failed earlier.

Conclusions: Lysis of adhesions provides a useful adjunct to ventriculoperitoneal shunt placement in children who have little options for distal catheter placement. The infection and failure rate in these patients are high.

80. A Novel Method for Cerebrospinal Fluid Diversion Utilizing the Sternum: A Cadaveric and Animal Study

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Introduction: Additional distal sites for placement of cerebrospinal fluid (CSF) diversionary shunts may be necessary in some patients. We aimed to investigate the sternum as a potential receptacle for CSF in patients with hydrocephalus.

Methods: Five fresh adult human cadavers underwent suprasternal cannulation of the manubrium. Tap water was infused via a metal trocar for 60 minutes. Morphometric examination of the manubrium from 40 adult human skeletons was performed. Four anesthetized rhesus monkeys underwent cannulation of the manubrium. Two monkeys were infused with 50cc of saline over one hour and two monkeys were infused by gravity drip of saline over 24 hours. Two adult pigs underwent long-term ventriculosternal tube placement.

Results: Thirty liters of water was easily injected into all cadaveric specimens without infusion site overflow, noticeable body edema, or fluid accumulation in body cavities. The manubrium had a mean length, width and thickness of 5.1cm, 5.0cm, and 1.0cm. Both animals undergoing 50cc infusion over one hour and the animals undergoing gravity drip over 24 hours tolerated the procedure without vital sign changes or evidence of saline leakage. In the latter two specimens, up to 1000cc was placed into the sternum over 24 hours. The two pigs showed no vital sign changes or symptoms of infection at six weeks post procedure.

Conclusions: Based on our cadaveric, osteological and animal studies, the manubrium of the sternum appears to be a possible location for the placement of the distal end of a CSF diversionary shunt when other anatomical receptacles are less acceptable.

81. Meningioangiomas: Clinical, Pathological and Radiographic Review of Six Cases

Susan C. Williams, MD; David Zagzag, MD; Werner Doyle, MD; Jeffrey Wisoff, MD (New York, NY)

Introduction: Meningioangiomas (MA) is a rare, benign focal lesion of the leptomeninges that can occur sporadically or in association with neurofibromatosis (NF). In sporadic cases, the presentation is usually a solitary lesion found in a child or young adult presenting with seizures. In cases associated with neurofibromatosis, the lesions are often multiple, asymptomatic and not associated with seizures. We present one of the largest series of patients with meningioangiomas and evaluate the efficacy of two-stage epilepsy surgery and gross total resection (GTR) on seizure outcome.

Methods: The neuropathology database was queried for all cases of meningioangiomas from 2002-2009. The clinical, histopathological, radiological and surgical outcome of six patients with MA was assessed. Surgical outcome was determined on neurological exam and post-operative MR scans obtained at follow-up. Seizure outcome was determined by Engel classification.

Results: Mean age at presentation was 13 years (range 5-19 years). Two patients presented as an incidental finding, four patients had intractable epilepsy including three with complex partial seizures and one with generalized tonic-clonic seizures. All cases were single lesions and no patients had clinical or radiographic evidence of NF-2 on initial presentation. GTR was obtained for all lesions without evidence of recurrence on follow-up MR. Duration of follow-up ranged from five months to six years. All patients with intractable epilepsy were Engel Class I after GTR.

Conclusions: Meningioangiomas is a rare lesion of the leptomeninges that can occur sporadically or in association with neurofibromatosis. We present one of the largest series of patients with MA and demonstrate the value of GTR in these patients.

82. Infant Arachnoid Cysts have a Different Natural History than Arachnoid Cysts in Later Childhood

Ashutosh Singhal, MD; Daria Krivosheya, MD; D. Douglas Cochrane, MD; Paul Steinbok, MD (Canada, Vancouver)

Introduction: Pediatric arachnoid cysts can be diagnosed as an incidental finding in head imaging studies. The literature provides little to guide decision making regarding need for follow-up. Given the limited natural history studies for this condition, the current study aims to examine growth patterns over time, and to identify any factors that are associated with cyst growth.

Methods: A retrospective chart review of pediatric patients with a diagnosis of intracranial arachnoid cyst was performed, selecting patients who did not initially undergo surgical intervention. Using cyst volume calculation on serial images, we determined whether asymptomatic arachnoid cysts in this population of patients change in size over time.

Results: 51 asymptomatic non-operated intracranial arachnoid cysts were identified. The majority of arachnoid cysts did not grow ($n=38$, 75%) on serial imaging, while 20% ($n=10$) increased in size and 6% ($n=3$) decreased. In patients diagnosed under 1 year of age, 9/18 showed growth of the cyst, while only 1/33 patients diagnosed over 1 year of age showed growth of the cyst ($p<0.0001$). The location and initial size of the cyst did not appear to correlate with cyst growth.

Conclusions: This represents the largest natural history study of pediatric arachnoid cysts, to date. Age at diagnosis correlated with growth of the arachnoid cyst, with infants having a high probability of growth. It may be that close serial imaging is justified in the younger child diagnosed with an asymptomatic arachnoid cyst, while less frequent imaging is indicated in the older child.

83. HASTE MRI in Children with Hydrocephalus

Brent Oneill, MD; Ryan Robison; Kieko Weir; Harman Bains; Sumit Pruthi, MD; Samuel Browd, MD, PhD (Seattle, WA)

Introduction: Recent reports and our clinical experience have shown the usefulness of rapid-acquisition MRI in evaluating children with hydrocephalus while avoiding the radiation exposure associated with frequent head CTs. This report reviews the Seattle Children's Hospital experience with rapid acquisition MRI with attention to ventricular size, overall image quality, motion artifact, and their effect on catheter visualization.

Methods: All HASTE (Half-Fourier Acquisition Single-shot Turbo Spin Echo) MRIs obtained at Seattle Children's Hospital over two-years were reviewed by two evaluators on scales of overall image quality, catheter visualization, motion artifact, and ventricular size. Logistical regression was used to determine the correlation between catheter visualization and the remaining three factors.

Results: Overall image quality was rated very good or excellent in 94% of the studies reviewed, while only one study was graded as poor. Significant motion artifact was noted in 7% while 77% had little or no motion artifact. Catheter visualization was rated as good or excellent in 57% of studies reviewed, poor in 36%, and misleading in 7%. Poor or misleading catheter visualization was not associated with motion artifact or poor overall image quality ($r^2 < 0.1$). Ventricular size showed a moderate correlation with catheter visualization (r^2 of .178).

Conclusion: Our study adds further support to the emerging evidence that HASTE MRI is an adequate substitute for CT scanning in evaluating ventricular size. Poor catheter visualization remains a problem that is not explained by motion artifact or poor overall image quality.

POSTER ABSTRACTS

84. Evaluation of a Wireless Intracranial Pressure Monitor

Alexandra Beier, DO; Prashant Kelkar, DO (Southfield, MI); Cathy Morgan, PhD (Ypsilanti, MI); Richard Fessler, MD (Detroit, MI)

Introduction: Intracranial pressure monitoring is the standard of care in severe closed head injury patients. Current devices require external attachments, subcutaneous tunneling, and coupling to transducers, making routine care and transportation of critically ill patients more difficult. We present our initial study of an auto-zeroing, wireless microelectromechanical system (MEMS, Integrated Sensing Systems Incorporated, Ypsilanti, MI) intracranial pressure (ICP) monitor.

Methods: Beagles ranging in weight from 9-11 kg were anesthetized and placed in a stereotactic frame. Three burr holes were created for: the Camino ICP monitor (Integra, Plainsboro, New Jersey), the MEMS sensor, and an epidural balloon (Maverick, Boston Scientific, Natick, MA). Intracranial pressure (ICP) measurements were taken at baseline, on day 8, and with epidural balloon manipulation.

Results: At implantation, the MEMS sensor mean was 27.6 mmHg (SD +/-2.3 mmHg) and Camino 26.9 mmHg (SD +/-2.1 mmHg). On day eight, the MEMS mean read 11.8 mmHg (+/- 1.8mmHg); the Camino measured 12.5 mmHg (SD +/- 1.6mmHg). On day 8, an epidural balloon was intermittently inflated to 8 ATM for periods ranging from 60-300 seconds. Camino and MEMS measurements were the same at five inflation points ranging from 32-34 mmHg. Following balloon deflation, the maximal variance in readings was 2 mmHg.

Conclusions: The authors present initial studies with a novel wireless ICP device. Overall, there was excellent correlation between the MEMS sensor and Camino monitors at implantation, at eight days, and with manipulation of ICP. Further studies are warranted to determine the clinical applicability of this innovative wireless device.

85. Giant Posterior Fossa Cavernomas in Infants with Familial Cerebral Cavernomatosis — The Case for Early Screening

Azam Basheer; Sean M. Lew, MD (Milwaukee, WI)

Introduction: Giant cavernous malformations are exceptionally rare in infants, and their appearance in the posterior fossa of an infant is even rarer. With only a few cases reported in the existing literature, we report two instances of giant posterior fossa cavernous malformations in two infants with the familial cerebral cavernomatosis.

Method: A 4 months-old boy presented with opisthotonos, gaze palsy and lethargy. MR imaging showed a multi-lobulated cavernoma in the fourth ventricle with evidence of bleeding and obstructive hydrocephalus. The second infant was 7 months-old at the time of diagnosis. She presented with neurological decline and lethargy but no focal neurological deficits. Imaging demonstrated a large lesion involving both the brainstem and cerebellum, with obstructive hydrocephalus.

Result: Both patients required immediate surgical intervention via external ventricular drainage and posterior fossa craniotomies, giving excellent results in both infants.

Conclusion: In both cases, patients presented in extremis with obstructive hydrocephalus and brainstem compression. These cases suggest that infants in families with suspected or confirmed familial cavernomatosis should be screened at an early age to reduce the likelihood of catastrophic presentations.

86. Treatment of Chiari I Anomaly Associated with Craniosynostosis

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

Introduction: The optimal management of Chiari Anomaly (CA) in the setting of craniosynostosis is not established. We report a series of pediatric patients with synostosis who have also been diagnosed with CA.

Methods: We reviewed a consecutive series of patients that were evaluated for craniofacial disorders over a 15-year interval. 39 patients out of 385 patients with craniosynostosis had CA.

Results: CA was seen in patients with isolated lambdoid synostosis (50%), coronal synostosis (8%), sagittal synostosis (4%), multisutural synostosis (44%), and pansynostosis (80%). In patients with craniosynostosis and CA, 36% also had syringomyelia. Additionally, 46% had sleep disturbances, 28% had occipital venous abnormalities, 38% were syndromic, and 51% had shunted hydrocephalus. 17 of 39 had CA diagnosed before undergoing cranial vault surgery. Of these patients, 5 had Chiari decompression performed with the CVR and 4 had Chiari decompression at an extended interval following CVR. Of the 8 patients with CVR alone, 7/8 demonstrated decreased tonsillar ectopia, 7/8 had improved CSF flow studies, and 3/3 showed syrinx regression. The 9 with both CA decompression and CVR had 6/9 with stable ectopia and 7/9 with improved CSF flow studies. In 12 patients with CA diagnosis occurring after primary craniosynostosis repair, 5 had multiple cranial vault expansions and had evidence of elevated ICP. In 5 cases, de novo CA development was documented following CVR at a mean interval of 3.9 years after the primary CVR.

Conclusions: Chiari malformation is frequently seen in patients with craniosynostosis. CA, and even spinal cord syrinx, will occasionally resolve following craniofacial repair.

87. Growth and Morphometrics of Arachnoid Cells on Collagen Scaffolds

Cornelius H. Lam, MD (Minneapolis, MN); Eric A. Hansen, PhD (Minneapolis VA Medical Center, MN); Allison Hubel, PhD (Minneapolis, MN)

Introduction: The importance of arachnoid cells in the removal of cerebrospinal fluid and debris/particulates is well known. The major extracellular matrix protein for native cells is collagen, which is also a major component of tissue engineered products. Our goal is therefore to define the growth pattern and morphometrics of arachnoid cells on this substrate as a foundation for the engineering of artificial arachnoid granulations.

Methods: Cells are harvested from rat pia-arachnoid along the anterior pontine region and cultured in Dulbecco's modified media. They are then plated on two dimensional wells and seeded onto three dimensional scaffolds of collagen with pore size of approximately 100 microns. Cell growth is characterized by hemocytometry and DNA content using the Qiagen DNA extraction Minikit. Morphometrics of two dimensional scaffold cells were performed with NIH ImageJ software in a PC attached to an Olympus Accu-scope.

Results: Cells had a doubling time of approximately 48 hours, with the three dimensional scaffold similar to traditional two dimensional culture cells. The growth was sensitive to collagen origin, seeding method, and age of cell source. Cells were spindly but became flatter as they populate the scaffolds as demonstrated by immunohistochemistry and SEM. Surface area increased linearly until confluence.

Conclusions: The behavior of arachnoid cells on the three dimensional scaffold is encouraging for its use as substrate for a tissue engineered structure. Its cell geometry is similar to those found in native tissue, and could be maintained ex-vivo for prolonged periods. This data lays the groundwork for exploring the transport properties of arachnoid cells in engineered constructs.

88. Transport Properties of Arachnoid Cells

Cornelius H. Lam, MD (Minneapolis, MN); Eric A. Hansen, PhD; Vamsi Dwaram, MD (Minneapolis VA Medical Center, MN); Allison Hubel, PhD (Minneapolis, MN)

Introduction: The arachnoid granulation is thought to be a major mode of egress for cerebrospinal fluid. The mechanism is however not clear. We attempt to quantify intracellular/extracellular egress in arachnoid cells cultured in transport chambers.

Methods: Arachnoid cells are harvested from rat pia arachnoid and cultured in Corning Transwells. The cells were subjected to pressure gradients from 0 to 4 cm of H₂O in an Issing diffusion chamber. Indigo carmine and Trypan blue were used to determine medium size molecule transport, and flow was quantitated by a Packard Spectracount photospectrometer. To quantitate intracellular transport, India ink particles were used. Standard mannitol transport analysis for barrier formation and transcellular electrical resistances (TEER) were also measured.

Results: With .3 micron sized Transwell, indigo carmine and Trypan blue passed slowly. Larger pore size permitted faster egress of dye with equilibration under one hour, while .3 micron polystyrenes took over 24 hours. At higher pressures, dye transport were shorter, but with two dimensional scaffolds, transport rate was very sensitive to pressure gradients. Cells would ingest India ink in a bimodal manner. Mannitol data suggests that arachnoid cells may form barriers similar to blood brain barrier cells although not to the same magnitude. This was confirmed with TEER values approaching 170 ohms.

Conclusions: Ussing diffusion chamber is an ideal means for studying extracellular transport. We demonstrate that ex-vivo cultures of arachnoid cells may exhibit passive pressure sensitive transport properties that correlate with the clinical observations. We also demonstrated intracellular energy dependent vesicular transport in ex-vivo cells.

89. Chondroid Hamartoma of the Cervical Spine in an Infant – A Case Report

Cuong J. Bui, MD; Manish Singh, MD (New Orleans, LA); Erin Biro, MD (New York, NY); Sunik Lee, MD; Olawale Sulaiman, MD, PhD; Roger Smith, MD; Kimsey Rodriguez, MD (New Orleans, LA)

Introduction: Chondroid Hamartoma (CH) is a benign pediatric tumor that is relatively rare. It most often presents as pulmonary lesions, however it has also been reported to occur at other locations along the respiratory tract including the trachea and nasopharynx. We describe the first known case of CH presenting as a cervical spinal mass in an infant. The patient is a ten-week-old boy who presented with spastic quadraparesis. CT/MRI showed a large dumbbell-shaped enhancing lesion involving the cervical spine and neck. The intraspinal, extradural component (4 x 2 x 1 cm) caused significant spinal cord compression, while the paraspinal component (2.5 x 1.5 x 2.5 cm) had significant mass effect on the left carotid artery and jugular vein. The two components connected via the left C5 neuroforamen. The lesion was treated via a two-stage surgical approach: 1) posterior C3-C7

laminoplasty with intraspinal tumor resection and foraminotomy, followed by 2) anterior neck dissection with paraspinal tumor resection. The pathology confirmed chondroid hamartoma. The patient did not receive any adjuvant therapy. At 6 months follow-up there was no recurrence and patient was doing well. We present a review of both the pathophysiology of CH as well as the literature. We also present diagnostic, histopathologic, and treatment nuances of this particular case. Awareness of this rare entity is important to both pediatricians and pediatric neurosurgeons.

90. Radiographic Follow-Up of Traumatic Intracranial Aneurysms Treated by Endovascular Techniques

Daniel H. Fulkerson, MD (Houston, TX); Terry G. Horner, MD; Troy D. Payner, MD; Thomas J. Leipzig, MD; John A. Scott, MD; Andrew J. DeNardo, MD (Indianapolis, IN)

Introduction: Traumatic intracranial aneurysms are rare lesions that are relatively more common in the pediatric population. Surgical repair or vessel ligation is the historical treatments of choice. However, many traumatic aneurysms arise in relation to the skull base. Ligation risks significant ischemia and repair may be complicated by anatomic constraints, clinical status of a recently injured patient, and the fact that these lesions are often pseudoaneurysms lacking a true vessel wall suitable for clipping. The indications and capabilities of endovascular treatment continue to expand. However, there are unanswered questions about the durability of treatment, especially in young patients. There are few reports examining the radiographic outcomes of endovascular treatment specifically for traumatic intracranial aneurysms. Therefore, we examined our experience treating these rare lesions in a pediatric population, concentrating on aneurysms near the skull base.

Methods: A retrospective review of prospectively collected data from 2000-2008 in a large, multi-disciplinary neurovascular center was performed.

Results: Three pediatric patients received endovascular treatment for traumatic intracranial aneurysms near the skull base. All patients had successful obliteration of their lesion without vessel sacrifice. Two patients required multiple procedures. There were no ischemic events related to treatment. Follow-up imaging ranged from 6 months to 2 years. There was no radiographic evidence of recurrence or re-growth of any aneurysm after completion of treatment.

Conclusions: Traumatic intracranial aneurysms at the skull base can be successfully treated with endovascular methods.

POSTER ABSTRACTS

91. Correlated Diffusion Tensor Imaging and Locomotor Behavior in an Animal Model of Neonatal Obstructive Hydrocephalus

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Introduction: Diffusion tensor imaging (DTI) is a powerful non-invasive tool to evaluate the structural integrity of distinct brain regions. Our preliminary work suggests a correlation with outcome in pediatric hydrocephalus (HCP). Nevertheless, clear correlations have yet to be defined.

Methods: HCP was induced in 2 day old rats by intracisternal injection of kaolin. DTI data were acquired from the cortex (Ctx) and caudate-putamen (CPu) of 6 HCP rats and 8 controls at postnatal days 7-9 (P7-P9) as well as 5 HCP rats and 3 controls (P10-12). Locomotor activity, which involves both basal ganglia (CPu) and cortex functions, was assessed in both group at P21 for habituation rate involving exploration in a novel environment.

Results: In the CPu, DTI parameters were normal at P7-9. At P10-12, the difference in axial diffusivity (Dax) became statistically significant ($p < 0.05$). In Ctx at P7-P9, HCP rats had significantly lower fractional anisotropy (FA, $p < 0.03$) and higher radial diffusivity (Drad, $p < 0.03$). At P10-P12, these difference remained significantly abnormal, and the difference in mean diffusivity (MD, $p < 0.03$) and Dax ($p = 0.16$) reached or approached statistical significance. In the behavioral test, the controls showed a typical pattern of initial exploration followed by habituation. However, untreated HCP rats demonstrated persistent hyperactivity at the same level as the initial exploration period.

Conclusions: The alterations seen in the DTI values in CPu and Ctx appear to be associated with subsequent abnormal locomotor behavior outcome in the hydrocephalic rats. Thus, DTI may provide effective non-invasive assessments of HCP outcome in this model.

92. Acute Suppurative Intracranial Complications of Sinusitis. A Single Institution Experience

Dhruve S. Jeevan, MD; John L. Gillick; Avinash Mohan, MD; Michael Tobias, MD (Valhalla, NY)

Introduction: Intracranial infections related to sinusitis are usually associated with chronic sinusitis. The objective of this study was to examine the management and outcome in children with acute presentation of sinusitis concurrent with suppurative intracranial complications at our institution.

Methods: We retrospectively reviewed the patient charts of a series of 6 paediatric patients, who presented with acute sinusitis associated with intracranial infections since August 2008.

Results: Six children (3 males and 3 females) underwent neurosurgical procedures at our institution for intracranial complications of acute sinusitis. Their ages ranging from 8 to 19 years (mean 13.5 years). The commonest presenting symptoms were headaches (100%), vomiting (50%), and swelling of the forehead (33%). The most often involved sinus was the frontal sinus (100%), and sinus surgery was performed in all 6 cases. The neurosurgical procedures carried out included burr hole drainage in three cases, craniotomy in two cases, and craniectomy in 1 case. Hyperbaric therapy was used as an adjunct to the treatment in three patients. The most common pathogen identified was streptococcus species. Follow-up ranges from 6 months to 1 year.

Conclusions: We present 6 pediatric cases in which intracranial infection occurred acutely without any prior history of sinus infection. Because both epidural abscess and subdural empyema often require immediate neurosurgical intervention, this emphasizes the need for early imaging, evaluation, and treatment. The degree of surgical intervention was tailored to the extent of disease, and hyperbaric therapy may be a useful adjunct to antibiotic treatment. Early recognition of intracranial infection allowed for prompt intervention.

93. Gross Total Resection of a Cervical Atypical Teratoid/ Rhabdoid Tumor in a 4-year-old with C5- C7 Instrumented Fusion with Lateral Mass and Translaminar Screws: Case Report

Eamon J. McLaughlin, BA; Gregory G. Heuer, MD, PhD; Luv R. Javia, MD; Bert W. O'Malley, MD; Phillip B. Storm, MD (Philadelphia, PA)

Introduction: Atypical Teratoid/Rhabdoid Tumors (AT/RT) are rare, highly aggressive tumors of early childhood, which normally present in the cerebellum. Spinal locations for AT/RTs are incredibly rare. The best course of treatment for non metastatic disease involves a combined approach of tumor resection, radiation and chemotherapy.

Methods: The authors report the case of a 4 year 1 month-old boy who presented with unilateral shoulder and hand pain and was found to have a cervical mass on imaging. A metastatic workup was performed and was negative for disseminated disease. A needle biopsy confirmed an AT/RT on histological examination.

Results: Using a posterior approach a C5-C6 laminectomy and right side bone facetectomy was performed to access the tumor. The proximal tumor and C6 nerve root were then resected posteriorly. The C6 nerve had demonstrated no distal response when stimulated proximal to the tumor. Residual tumor around the vertebral artery was then carefully dissected off the vessel. The bulk of the tumor was then removed en bloc through an anterior approach. The cervical spine was stabilized on the left side using a C5 lateral mass screw and a C7 translaminar screw connected with a titanium rod. The right side was reconstructed using iliac crest allograft from C5-C7. The graft was secured using a Songer cable.

Conclusion: Gross total resection of a large intra and extraspinal AT/RT can be done safely using a combined anterior/posterior approach. Instrumented fusion with rods and screws even in a 4-year-old can be done safely and does not require autologous bone or halo placement.

94. Management of a Bronchocutaneous Fistula and Psuedoarthroses after Resection of a Malignant Peripheral Nerve Sheath Tumor through a T4-T10 Costotranversectomy: Case Report and Description of Operative Technique

Eamon J. McLaughlin, BA; Gregory G. Heuer, MD, PhD; Robert G. Whitmore, MD; Daniel Serman, MD; David Low, MD; Phillip B. Storm, MD (Philadelphia, PA)

Introduction: Malignant peripheral nerve sheath tumors (MPNST) are highly aggressive tumors which carry a poor prognosis. The best chance for long-term survival and possible cure is complete surgical resection, along with adjunct radiation and chemotherapy.

Methods: The authors report the case of a 14-year-old girl with residual MPNST after thoracotomy, chemotherapy, and radiation therapy. A staged 2-day aggressive surgical procedure was offered at our institution to in an attempt to achieve gross total resection (GTR).

Results: The residual tumor involved the intercostals, aorta, and neural foramina of T4-T10 and was completely resected through a costotransversectomy and multiple hemilaminotomies in the prone position, and stabilized with a T1-T12 pedicle screw fusion.

Postoperatively the patient developed multiple infections requiring multiple washouts and prolonged antibiotics. Thirty months after surgery she developed a bronchocutaneous fistula. The hardware was removed and a vascularized free flap of latissimus dorsi was placed over the lung. She continued with an airleak and presented 3 weeks later with a 50 degree left thoracic curve. She returned to the operating room for a T2-L2 fusion with a vascularized fibular graft. Postoperative day 1 she underwent a bronchoscopy and had her left lower lung closed with a novel one way valve.

Conclusions: The patient is now 5 years out and is tumor free and has no evidence of pseudoarthrosis. The risk of severe complications from aggressive resection after radiation therapy is very high. However, when a cure is possible and a multi disciplinary approach is used to treat and avoid complications, the benefits outweigh the risks.

95. Congenital Hydrocephalus: Prognosis and Outcomes with Postnatal Shunting

Edward S. Ahn; Stanley Hoang, BS; Jason Liauw, MD; George I. Jallo, MD; Benjamin S. Carson, MD (Baltimore, MD)

Introduction: Congenital hydrocephalus results from various etiologies including neurodevelopmental anomalies, chromosomal disorders, or fetal insults. Often, the diagnosis is made prenatally and clinicians are challenged with decisions about timing of delivery, shunting, and prognostication.

Methods: Review of records and imaging studies to assess timing of delivery, mortality, shunt placement, shunt survival, and complications.

Results: From 1985 to 2009, 54 cases were diagnosed, with 76% detected prenatally. The leading cause of hydrocephalus was aqueductal stenosis (28%), followed by Dandy-Walker cyst (15%). Other common causes include Chiari malformation, agenesis of corpus callosum, and cysts. The average gestational age at delivery was 33.6 weeks. The mortality rate, with and without shunting, was 28%. The median postnatal age of death was 21 days. There were 34 infants (63%) who were shunted with an average gestational age at operation of 36.5 weeks and a mean follow-up of 4.5 years. Of these shunted patients, 56% required a revision and 29% required multiple revisions. The one-year shunt survival rate was 53%. 74% of the failures were due to shunt malfunction while 21% were due to infection. There were no statistically significant differences in rate of shunt failure with respect to gestational age at birth, gestational age at shunt placement, or postnatal age at shunt placement.

Conclusions: Congenital hydrocephalus can be effectively treated with shunting despite prematurity; however mortality remains high due to comorbidities. The shunt-survival rate is comparable with other populations of shunted infants. There is no apparent difference in shunt failure between early and late shunting.

96. A Longitudinal Model of Head Circumference in Children with Benign Enlargement of the Subarachnoid Space

Erin Kiehna, MD; Robert M. Starke, MD; Charles A. Sansur, MD; John Jane Jr., MD (Charlottesville, VA)

Introduction: Benign enlargement of the subarachnoid space (BESS) is a self limiting condition found in asymptomatic macrocephalic children. They are usually referred to neurosurgeons after their head circumference (HC) begins to cross percentiles. Over the past decade, we have sought to create a mathematical model of the longitudinal changes in HC.

Methods: Between 1999 and 2009, 84 patients were diagnosed with BESS on the basis of serial HCs and neuroimaging demonstrating a prominent interhemispheric fissure and increased subarachnoid fluid over the frontal convexities. Analysis was carried out using independent generalized estimating equations linear regression to generate a population averaged interpretation of the relationship between age and increasing HC in patients with BESS.

Results: For all 84 patients, median age at diagnosis was 9 months (range 2 weeks - 30 months) with a median HC of > 97% at diagnosis. The majority were male (80%). When HC is modeled over the first twenty four months, $HC = 40.23 + .675 \times \text{age in months}$. $R^2 = .68$.

Conclusions: We describe a model for predicting HC in children with BESS. Utilizing this model will enable practitioners to predict and assess HC over time. In an asymptomatic infant with macrocephaly, if the child is following our predicted curve, the diagnosis of BESS can be made and external hydrocephalus may be excluded. If the HC does not follow their growth curve after 12 months then further evaluation is needed to assess the etiology of the child's macrocephaly as it may not be benign.

97. Aqueductal Stenosis Presenting as Isolated Tremor: Case Report and Review of the Literature

Francis A. Seiler; Edward Kovnar, MD; Sean Lew, MD (Milwaukee, WI)

Introduction: Essential tremor is rare in children, particularly in the absence of a significant family history. We report the case of a child with compensated hydrocephalus secondary to aqueductal stenosis whose sole presenting symptom was tremor.

Method: An otherwise healthy 6 year-old male developed a fine hand tremor, which over the course of four years both increased in intensity and spread to involve the lower limbs and head.

Result: After an MRI confirmed hydrocephalus due to aqueductal stenosis the patient underwent an endoscopic third ventriculostomy (ETV). His tremor markedly improved, but did not completely resolve.

Conclusion: Occult hydrocephalus should be considered in the differential diagnosis of new onset tremor. Progression of the tremor should halt with treatment of the hydrocephalus, and clinical improvement may be seen.

POSTER ABSTRACTS

98. Uncrossed Motor Representation in a Child with Shunted Congenital Massive Hydrocephalus

Henry Jung, BS; Jordan P. Amadio, BS; Michael Rivkin, MD; R Michael Scott, MD; Joseph R. Madsen, MD (Boston, MA)

Introduction: We report a case of a 10 year old boy with congenital hydrocephalus found to have an uncrossed motor system during an evaluation for intractable seizures.

Method: We reviewed fMRI studies, motor mapping and grid and strip electrodes for seizure localization carried out as part of a pre-operative evaluation for epilepsy surgery in a 10 year old boy with history of shunted massive hydrocephalus and temporal lobe porencephalic cyst.

Result: The patient's fMRI revealed an uncrossed motor system, with virtually complete ipsilateral representation of motor function. Invasive monitoring confirmed seizure localization to large regions of his right temporal lobe, which was resected. His shunt was removed, and he has done very well clinically.

Conclusion: Hemispheric specialization or lateralization of function is a fundamental property of human developmental neuroanatomy crucial to an understanding of functional neurosurgery. Although massive hydrocephalus in early life causes anatomical distortion, its lasting impact on functional brain architecture is poorly understood. Virtually nothing is known about abnormal cortical lateralization or projection in cases of treated hydrocephalus, since the majority of these patients never undergo functional mapping. Massive hydrocephalus appears to permanently disrupt the developmental trajectory of the brain, resulting in an alternative functional architecture; our patient developed grossly intact motor function with ipsilateral representation. Embryologic principles of corticospinal system development suggest mechanisms for this rarely observed dominance of ipsilateral over contralateral projections. Functional mapping in other cases of treated hydrocephalus may show similar abnormalities of cerebral organization, which may add to our knowledge of cerebral plasticity after injury.

99. New Insights Belie the Role of Kernohan's Incisura of the Crus in Underpinning Ipsilateral Findings

Iraj Derakhshan, DR (Charleston, WV)

Introduction: Kernohan and Woltman investigated the role of a notch seen in the right cerebral peduncle of a patient with spasticity and Babinski sign on the left.

Methods: A two track analysis of similar cases was undertaken. The distribution of ipsilateral pyramidal findings among the 40 eligible cases is shown in their figure 7.

Results: Among the supratentorial instances studied, midbrain notching was asymptomatic in 18 and associated with ipsilateral findings in 17. Clearly, notching could not be a satisfactory explanation for occurrence of signs ipsilateral to an expanding mass. Given the above distribution, however, it is apparent that "the cause of lateralization errors" was the laterality of the lesions they studied (i.e. whether the major or minor hemisphere harbored the lesion).

Conclusions: According to the new understandings, malfunctioning of the right (minor) hemisphere in cases with signs ipsilateral to the major hemisphere was due to the deafferentation of the latter from the excitatory commands arising from the major hemisphere; i.e. von Monakow's diaschisis. Conversely, the asymptomatic cases were those in whom the minor hemisphere harbored the lesion irrespective of a notch present. Accordingly, the minor hemisphere implements the commands arising from the major hemisphere for movements occurring on the nondominant

side of the body. This interpretation is consistent with reports of structurally normal right motor pathway in cases with left spastic hemiparesis with lesions affecting the left hemisphere. These observations points to the excitatory nature of the commands issued by the major hemisphere, which are transferred transcallosally to the minor as confirmed recently.

100. Cause of Hydrocephalus in Mice Expressing Heparin Binding EGF like Growth Factor

Joon W. Shim, PhD; Johanna Sandlund, MD, PhD; Bart MacDonald, MD; Mustafa Q. Hameed, MD; Nina Irwin, PhD; Gerhard Raab, PhD; Yanping Sun, PhD; Michael Klagsbrun, PhD; Joseph R. Madsen, MD (Boston, MA)

Introduction: Heparin-binding epidermal growth factor (EGF)-like growth factor (HB-EGF) is a member of the EGF family of growth factors mediating multiple physiological pathways. Several transgenic mice involving HB-EGF have been reported but the hydrocephalic phenotype remains undetermined.

Methods: Transgenic mice expressing mature form of human HB-EGF were constructed with the partial deletion of transmembrane form to examine effect of human HB-EGF in vivo.

Results: More than twenty percent of the mutant showed symptoms reminiscent of hydrocephalus in magnetic resonance imaging. Also, lacZ/beta galactosidase (b-gal) activity was abundant in the hydrocephalic phenotype. The positive lacZ staining was distributed radially from subependyma to the cortex as well as tangentially to the olfactory epithelium in the presence of ventriculomegaly. In the non-hydrocephalic phenotype, however, b-gal activity was limited to tangential distribution towards the olfactory bulb, where the organization of apical surface revealed by ependymal cell marker, beta-catenin, appeared to be intact. In parallel, intraventricular infusion of recombinant human HB-EGF into wild type rats resulted in ventriculomegaly with high permeability.

Conclusions: These data propose three compelling hypotheses. First, overexpression of HB-EGF may promote tangential as well as radial migration, which in turn causes absence of subependymal cells leading to the ventriculomegaly. Second, the deletion of transmembrane HB-EGF might be linked to hydrocephalus. Third, excessive angiogenesis due to HB-EGF might be the cause. This model might significantly reshape our understanding to the migratory aspect of nerve cells known for EGF and excessive angiogenesis reported for other heparin binding growth factors in association with hydrocephalus.

101. Changes in Thermal Flow Determinations with Changes in Valve Settings in Shunted Hydrocephalic Patients

Joseph R. Madsen, MD; Gani Abazi, MD, MPH; Tomer Anor, PhD; Laurel Fleming, BA (Boston, MA)

Introduction: Thermal measurements from the ShuntCheck® device nominally show "flow" or "flow not confirmed" (FNC) in ventriculoperitoneal (VP) shunts. We investigated clinical implications in six patients who underwent adjustments of variable-pressure valves for various clinical reasons, to determine whether such changes altered flow detected by the device.

Methods: Six shunted hydrocephalic patients with adjustable valves, complaining of headaches, fatigue, or abdominal discomfort were tested for flow with the ShuntCheck device before and after valve setting adjustment. The patient with abdominal discomfort was tested before and after a Strata resetting from PL 2.5 to 0.5. The remaining five patients were tested during clinic visits where therapeutic valve resetting was attempted.

Results: Adjustment of Strata valve setting improved headaches in three out of four patients complaining of headaches and improved subjective fatigue in the fifth patient. In three out of four of the patients with improvement, a change in flow pattern was observed. The patient in whom a change in the flow pattern could not be documented showed no symptomatic improvement. In the abdominal pain case, no flow could be determined with either setting and the shunt was externalized, found to be occluded (and apparently unnecessary) and removed.

Conclusions: ShuntCheck may detect changes in flow when a valve setting is changed, which may prove of value in treating symptomatic patients with adjustable valves. Further, flow determinations may help predict shunt independence in specific patients. Further study would be warranted to determine the optimal use of flow information in shunted patients.

102. Intermittency of VP Shunt Flow in an Asymptomatic Subject during Day-to-Day Activities

Joseph R. Madsen, MD; Peter Casey, MD; Tomer Anor, PhD; Gani Abazi, MD (Boston, MA)

Introduction: Experience with the ShuntCheck® thermal flow detector with single readings in asymptomatic shunted outpatients has produced the unexpected finding that approximately 50% of tests read “no flow confirmed.” We addressed the question of flow intermittency in a single asymptomatic subject, having never required shunt revision in 19 years.

Methods: Twenty-one thermal cerebrospinal fluid (CSF) flow studies were performed immediately after various bodily postures and various activities (including exercise, overnight sleep, and Trendelenburg position) over a five day span. A supine test was performed first, followed by a sitting test if no flow was detected in the supine test. The ShuntCheck sensors were left in place over the course of each day to minimize effects of device placement.

Results: Tests yielded 56% “no flow confirmed”, while 44% read “flow confirmed.” No single activity consistently produced either “flow detected” or “flow not detected” results, but tests taken after waking up and three minutes of movement yielded the most consistent shunt flow. A supine test after sitting up at a 45° angle seemed to give the lowest reading.

Conclusions: This is the first study where multiple, controlled assessments of CSF flow in a shunt were tested during activities simulating normal life of a subject with a VP shunt. Intermittency of flow likely accounts for the finding of frequent “flow not confirmed” readings in asymptomatic outpatients. Additional maneuvers may distinguish pathological shunt obstruction without flow from this intermittent finding of an undetectable flow state.

103. Treatment of Third Ventricular Choroid Plexus Papilloma in an Infant with Embolization Alone

Joshua J. Wind, MD; John S. Myseros, MD; Robert F. Keating, MD; Amanda L. Yaun, MD; William O. Bank, MD (Washington, DC)

Introduction: Choroid plexus papillomas (CPPs) of infancy present a surgical challenge, particularly third ventricular lesions. We present an infant with third ventricular CPP successfully treated with embolization alone.

Methods: A 3-month-old boy presented with macrocephaly, irritability, inability to roll over, and vomiting. Physical examination demonstrated head circumference measuring 49.5cm, a full and tense fontanelle, splayed sutures, and forced downward gaze. Imaging revealed severe ventriculomegaly and a brightly enhancing third ventricular lesion consistent with CPP. Treatment planning included placement of shunt to treat hydrocephalus and to allow the child to grow prior to resection. Although no infection occurred, shunt externalization was required due to excessive CSF overproduction, with outputs of >1000cc/day. In order to decrease CSF production to allow for reinternalization of the shunt and to diminish arterial flow to the tumor before planned surgery, the tumor was embolized with Onyx injection into the right medial posterior choroidal artery. The shunt was subsequently reinternalized.

Results: The child tolerated all procedures well. Given the large ventricles, subdural collections evolved and subsequently resolved, but on serial imaging the tumor steadily regressed. By 7 months and subsequently 12 months post-embolization, there was no radiographic evidence of tumor.

Conclusion: Pre-operative embolization of papillomas in infants has been well described and used in our institution routinely. This is the first case, however, of complete radiographic resolution of such a lesion with embolization alone. Given the young presenting age of these children and inherent risks of operating on such vascular lesions within the third ventricle, curative embolization may be a treatment option.

104. How to Determine the Location of the Conus-Filum Junction

Kamal R.M. Woods, MD; Shokei Yamada, MD, PhD (Loma Linda, CA); Daniel J. Won, MD (Fontana, CA); Austin R.T. Colohan, MD (Loma Linda, CA)

Introduction: A number of articles have indicated that spinal cord elongation is a diagnostic criterion for tethered cord syndrome (TCS). The authors questioned the reliability of this criterion, and studied the location of the conus-filum junction.

Methods: In 131 TCS patients, the conus-filum junction was determined at surgery by the location where the lowest coccygeal nerve root exited. The inelastic filum was resected just caudal to the conus-filum junction and examined histologically. In 10 cadavers, the conus-filum junction was determined by the same method, and the distal conus and three segments of the filum were examined histologically for neuronal tissue.

Results: In all cadavers, the conus-filum junction was located between the T12-L1 and the L2-L3 interspaces. Spinal cord elongation (defined as conus-filum junction below the L2-3 interspace) was identified in 37% of adult and late-teenage TCS patients, and in 80% of younger children. All filum specimens from both patients and cadavers lacked neurons, whereas cadaver specimens taken above the lowest coccygeal nerve showed neurons. In TCS patients, glial tissue in the filum was completely replaced by fibrous or fibroadipose tissue.

Conclusions: The location of the conus-filum junction cannot be reliably determined with current MRI resolution, since the lowest coccygeal nerve root measures only 100-150 µm in diameter. From the results of this study, the authors believe an accurate diagnosis of TCS should be based on clinical signs and symptoms, posterior displacement of the filum, and the stretch test.

POSTER ABSTRACTS

105. Treatment of Acute Atlanto-Axial Rotatory Subluxation

Keyne K. Johnson, MD; Jogi Pattisapu, MD; Christopher Gegg, MD; Greg Olavarria, MD (Orlando, FL)

Introduction: The treatment of acute of atlantoaxial rotatory fixation still remains a topic for debate. The typical presentation is acute torticollis with restricted painful movement of the neck. The onset can be spontaneous, following an infection or minor trauma.

Methods: We retrospectively reviewed 6 patients diagnosed on CT as having atlantoaxial subluxation. The average age of the patients was 6 years old. The degree of subluxation was measured using the Fielding and Hawkins classification scheme. All patients had torticollis and neck pain with decreased cervical motion. Only one patient demonstrated a spontaneous onset, the other five patients presented after minor trauma.

Results: All patients had Fielding type II or III injuries and presented with painful torticollis. The average time from injury to presentation was 1 day. One patient was treated with versed and immediate improvement was noticed. The other 5 patients were treated with valium and again within 2 hours all patients had resolution of their torticollis. Only 2 had some residual pain but were sent home with pain meds and were pain free when seen back for follow up in 2 weeks. No patient had a recurrence.

Conclusion: Despite the discrepancy with both the definition and treatment of acute atlantoaxial rotatory subluxation or atlantoaxial rotatory fixation we demonstrated that these phenomena are easily treated non-operatively without traction or surgery when diagnosed immediately only using sedation and muscle relaxants. Therefore, the definition to not only classify this condition but also properly treat should include duration of symptomatology.

106. Autonomic Dysreflexia Following Spinal Cord Transection

Manish Singh, MD (New Orleans, LA); Erin Biro, MD (New York, NY); Sunic Lee, MD; Olawale Sulaiman, MD, PhD; Roger Smith, MD; Cuong J. Bui, MD (New Orleans, LA)

Introduction: Spinal cord transection is a radical but an effective treatment option in highly selective cases of symptomatic spinal cord tethering in paraplegic spina bifida patients. The primary advantage for such an extreme measure is the ability to provide definitive untethering versus risking addition untethering procedures due to the 25-30% retethering rate. It is reported that the risk-benefit ratio declines dramatically after 2 untethering procedures. There are very few reported complications associated with this procedure. Autonomic dysreflexia is a syndrome of imbalanced reflex sympathetic discharge commonly found in cervical and high thoracic spinal cord injury patients. The purported mechanism for the symptomatic dysreflexia is the loss of central input and control to the splanchnic sympathetic outflow, usually located at or below the spinal level of T6. We report the first case of new onset autonomic dysreflexia following spinal cord transection procedure. The patients underwent a T12 level cord transection without any significant intra-operative complication. The patient developed intermittent episodes of significant hypertension, bradycardia, headaches, and flushing of head and upper body within 2 days of surgery. The patient was treated successfully with a combination of behavior/care-giver modifications and oral beta blockade. The patient is doing well at 2 year follow-up. We will review the literature on this subject matter and discuss possible mechanisms and altered pathways involved in this unusual case. Being aware of this potential complication and its treatment options is important for neurosurgeons and physical medical and rehabilitation physicians.

107. TGF- β Family and Its Receptors Smads in Neural Tube Closure Defects - Further Support for Prenatal Surgical Intervention — Chick Embryo and Human Samples

Mehmet Selcuki, MD, PhD (Izmir, Turkey)

Introduction: Neurulation proceeds in a series of steps by which the neural plate is shaped elongated and bent to form a tube that extends the entire length of the anterior-posterior axis. Members of the TGF- β superfamily regulate a broad range of cellular functions. The signals of TGF- β superfamily are transduced intracellularly with Smad family of gene products as transducers for TGF- β . The Smad family has three subgroups. The first group is receptor-regulated Smads (R-Smads; Smad 1, 2, 3, 5, 8), the second group is common mediator Smads (Co-Smads; Smad-4) and the third class is the inhibitory Smads (I-Smads; Smad-6, Smad-7).

Methods: We investigated expressions of TGF- β members (TGF- β 1, TGF- β 2, TGF- β 3) and Smads (Smad 1-2-3, Smad 6, Smad 7) in human samples with NTD and compared the expression of these molecules with expression in normally developed chick embryos.

Results: As a result, same molecules were found to be at similar amount in spatial and temporal context. The findings suggested that maturation and differentiation of neural tissue continued regardless of the failure of neural tube closure. These results support the findings that have been achieved in another investigation.

Conclusions: Therefore, the neurological deficits that are encountered in NTD patients might be related to secondary damage such as amnion fluid toxicity, uterus contractions, labor, etc. It seems valuable to save the neural plate before the negative effects of the environment renders the neural tissue functionless.

108. Effects of Experimental Neonatal Hydrocephalus on White Matter Integrity

Melissa Mason; Kelley E. Deren, MS (Salt Lake City, UT); Weihong Yuan, PhD; Francesco T. Mangano, DO (Cincinnati, OH); James P. McAllister, II, PhD (Salt Lake City, UT)

Introduction: Diffusion tensor imaging (DTI) has shown potential as a reliable indicator of white matter abnormalities in hydrocephalus. This study was designed to correlate white matter DTI findings and cytopathology.

Methods: Obstructive hydrocephalus was induced by intracisternal kaolin injections in 1-day old rats. On post-injection days 8 and 21 MRI was performed to confirm ventriculomegaly and DTI was conducted to assess white matter integrity. Saline injected animals served as age-matched controls. Animals were sacrificed on post-injection days 8-12 and 21 for histological analysis. White matter tissue including the external (EC) and internal capsules (IC) and the fornix (FX) were analyzed using a semi-quantitative 3-point ranking scale for reactive astrocytes and microglia, and the presence of myelin.

Results: At 21 days post-injection, hydrocephalic tissue showed significant increases ($p < 0.001$) in reactive gliosis in the EC, IC and FX and a decrease in myelin, which were associated with DTI changes. At 8-12 days post-injection, DTI changes were statistically significant; furthermore, a less severe state of reactive gliosis and demyelination was seen at this age.

Conclusion: Our findings indicate gliosis and demyelination are prominent contributors of white matter pathology in hydrocephalus and are associated with DTI alterations. This study also presents DTI as a possible screening tool for cellular changes in the clinical setting.

109. Initial Results Using Intraoperative Magnetic Resonance Imaging in Pediatric Neurosurgery

Michael J. Geske; James Johnston, MD; John Evans; Matthew Smyth, MD; Michael Chicoine, MD; John Spitler, MD; Jeffrey Leonard, MD; David Limbrick, MD, PhD (St. Louis, MO)

Introduction: Intraoperative MRI (iMRI) has been used with increasing frequency over the last decade to help guide operative management in neurosurgical patients. The majority of studies published to date examining the use of iMRI focus on adult populations. Here, the initial experience of a large Children's hospital using iMRI in a pediatric population is examined.

Methods: Pediatric patients undergoing craniotomy with iMRI at St. Louis Children's Hospital are retrospectively evaluated. Cases spanned the period from April 2008 to July 2009.

Results: 29 patients, ages 1 to 22, underwent craniotomy with iMRI over the time period examined. The most common indication for craniotomy was tumor resection (n=22), followed by resection of an epileptogenic focus (n=6). In 11 cases (37% of all cases) surgical management was altered by the results of intraoperative scanning, resulting in further resection prior to closure. In cases done for tumor resection, gross total resection of tumor was achieved in 81% of cases.

Conclusions: Intraoperative MRI can be successfully and reliably used in a pediatric population. The use of iMRI in children can accurately identify extent of resection during surgery, and, subsequently, guide further resection if indicated.

110. Spontaneous Congenital Depressed Skull Fracture:

Case Report and Review of the Literature

Peter D. Kim, MD; Zulma Tovar-Spinoza, MD (Syracuse, NY)

Introduction: Spontaneous congenital depressed skull fractures constitute a rare entity with many presumed origins.

Method: We review the case of a neonate who presented with a significant non-traumatic congenital skull fracture. The scarce literature in this topic is reviewed.

Result: A full-term male born to an HIV positive mother was noted immediately after birth to have a depression in the left frontal area. CT scan of the head showed a significant depressed skull fracture. The pregnancy presented no history of trauma and ended in a term uncomplicated vaginal delivery. At two weeks of age surgical elevation of the fracture was performed. The patient was found to have good cosmetic result without post surgical complications. Review of the literature identified few reports of congenital skull fractures without clear precipitating factors. Surgical treatment, vacuum extraction and expectant approaches have all been reported with positive results. Spontaneous resolution of the fractures has been observed in specific cases.

Conclusion: Congenital skull fractures in the absence of reported trauma and normal delivery are rare. Surgical treatment in this case at two weeks of age resulted in satisfactory results. This is to our knowledge the first reported case of this entity associated with maternal HIV disease.

111. Lack of Efficacy of Vagus Nerve Stimulation in Children with Tuberous Sclerosis Complex Does Not Preclude Improvement Following Subsequent Intracranial Epilepsy Surgery

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Introduction: To assess the association of VNS therapy failure with seizure control outcome following device removal and subsequent intracranial epilepsy surgery in children with tuberous sclerosis complex (TSC).

Method: A retrospective review was performed on 9 consecutive children with refractory epilepsy and TSC who failed VNS therapy and underwent device removal and subsequent intracranial epilepsy surgery. There were 5 (56%) females and 4 (44%) males ages 2 to 18 years when the VNS was implanted (mean: 7.7 ± 5.6 years) and ages 3.5 to 20 (mean: 11.3 ± 6 years) at time of craniotomy.

Result: After a mean duration of VNS therapy of 3.9 ± 2.8 years, 9 children with poor response to VNS (Engel III and IV) underwent removal and craniotomy for one (7) or more (1) seizure focus resection or corpus callosotomy (1). At a mean follow-up of 4.4 ± 2.8 years following intracranial surgery, 8 (89%) patients experienced improved seizure control (mean reduction: 68.5%; range: 0 to 100%; $p < 0.05$). Modified Engel outcomes were: Class I_2 (22.2%), Class II_3 (33.3%), Class III_3 (33.3%) and Class IV_1 (11.1%).

Conclusion: In children with intractable epilepsy and TSC, lack of response to VNS therapy does not preclude subsequent improvement in seizure burden with intracranial epilepsy surgery.

112. Fusiform Dilatation of the Carotid Artery Following Radical Resection of Pediatric Craniopharyngiomas

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Introduction: Fusiform dilatation of the supraclinoid internal carotid artery (FDCA) is a rare but reported occurrence following surgery for suprasellar tumors, in particular craniopharyngiomas. We report our experience of FDCA following aggressive surgical resection of craniopharyngiomas in children.

Methods: Between 1986 and 2006, 86 children under the age of 21 underwent radical resection of craniopharyngiomas. Ten patients with less than 1 year of follow-up imaging or nonsuprasellar tumors were excluded. Data were retrospectively collected on these 76 patients (43 males/33 females; mean age: 9.5 years; mean tumor size: 3.3 cm) to determine the rate and clinical significance of FDCA.

Results: Fifty patients had primary tumors and 26 patients received treatment before referral to our center. Sixty-six children (87%) had gross-total resection (GTR). FDCA developed in 7 patients (9.2%), all of whom had primary tumors and GTR. Mean time to onset of FDCA was 6.8 months with stabilization occurring at mean of 17.7 months. Mean size of lesions was 9.1 mm (range: 7.1-12mm). No lesions experienced continued growth after arrest on serial imaging, had symptoms from or required treatment for FDCA. There were no significant differences in age, sex, tumor size, pre- or retrochiasmatic location or surgical approach ($p > 0.05$) between patients with and without FDCA.

Conclusions: FDCA occurred in fewer than 10% of children following radical resection of craniopharyngiomas. In agreement with other reports, FDCA is likely secondary to surgical manipulation of the supraclinoid carotid artery and should be managed conservatively since very few patients exhibit continued symptoms, growth or rupture.

POSTER ABSTRACTS

113. Recurrent Meningitis Associated with Frontal Sinus Tuber Encephalocele in a Patient with Tuberous Sclerosis: Case Report

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Introduction: Tuberous Sclerosis Complex (TSC) is a genetic neurocutaneous disorder. Most commonly associated brain tumors include cortical tubers, subependymal nodules and giant cell subependymal astrocytoma (SEGA). We report an unusual case of recurrent meningitis secondary to tuber invasion of the posterior wall of frontal sinus.

Methods: An eleven year old female patient with history of TS and previous SEGA resection via inter-hemispheric technique. She presented twice within 4 months with classic bacterial meningitis. CSF cultures revealed streptococcus pneumoniae. CT and MRI imaging of brain showed a right frontal sinus encephalocele via a posterior frontal sinus wall defect. Both attacks of meningitis were treated successfully with standard regimens of IV antibiotics. Neurosurgical service was consulted to discuss surgical options.

Results: Via a bicoronal incision, a right basal frontal craniotomy was performed. A large frontal encephalocele was encountered in the frontal sinus. Encephalocele was herniating through a bony defect of the posterior sinus wall. Encephalocele was ligated and resected followed by removing frontal sinus mucosa and complete cranialization of frontal sinus. Repair of sinus floor was done with fat and pericranial grafts followed by temporary CSF diversion. Histopathology of encephalocele was consistent with TS tuber covered with frontal sinus mucosa. Tuber cells were positive for GFAP and S100 and negative for synaptophysin. Patient was followed for 6 months without evidence of recurrent meningitis or CSF rhinorrhea.

Conclusions: This report demonstrates that TS frontal tubers can invade the frontal sinus and present with encephalocele-related recurrent meningitis attacks. Careful radiographic follow-up for frontal tubers in patients with TS is recommended.

114. Normal Computed Tomography Measurements of the Upper Cervical Spine in the Pediatric Age Group

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Introduction: Measurements used to diagnose upper cervical spine injuries are largely based on adult normal values and are inappropriately applied to children. In this study, we attempt to develop normal values for several upper cervical spine measurements in children.

Methods: Reformatted coronal and sagittal high-resolution CT scans were retrospectively reviewed in 42 consecutive children (mean age 101 months, 25 males) over a three-month period. Although most CTs were performed following trauma, no patient showed acute or delayed clinical evidence of cervical spine injury, and all scans were reported as normal by a pediatric neuroradiologist. The following measurements were obtained: atlanto-dental interval (ADI), basion-dental interval (BDI), posterior atlanto-dental interval (PADI), left and right craniocervical interval (CCI) and lateral mass index (LMI), and prevertebral soft tissue width at C2. Mean values and tolerance intervals (which estimate the upper limit of normal) were calculated. Age and gender effects were evaluated using linear regression analysis.

Results: The mean (upper tolerance limit) values for ADI, PADI, BDI, LMI, CCI, and soft tissue width were 2.3mm (2.8mm), 18.3mm (18.5mm), 7.3mm (7.5mm), 2.9mm (4.0mm), 2.4mm (3.4mm), and 4.5mm (5.5mm) respectively. With increasing age, PADI significantly increased, while BDI and CCI decreased. Females had significantly smaller PADI and CCI measurements.

Conclusions: We present a preliminary estimate of the expected range of normal values for upper cervical spine measurements in children. Further study must validate the ability of these measures to diagnose pediatric upper cervical spine injuries.

115. Shunt Independence Following Calvarial Expansion in a Patient with Slit Ventricle Syndrome

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Introduction: Slit ventricle syndrome is a difficult problem in pediatric neurosurgery. Patients with this syndrome often undergo multiple shunt revisions with little improvement in symptoms, and are plagued with frequent severe headaches. We present one patient who gained independence from her shunt after a calvarial expansion.

Methods: The patient, a 10-year-old girl, had undergone subdural-peritoneal shunt placement as an infant for macrocephaly and developmental delay in the setting of benign extra-axial collections of infancy. Her shunt was subsequently converted to a ventriculoperitoneal shunt. She underwent 46 revisions over the next decade. Acquired craniosynostosis was apparent on head CT. Subtemporal decompressions were performed in an attempt to increase the size of her ventricles, with minimal effect. A calvarial expansion was performed.

Results: The calvarial expansion produced low-pressure headaches that resolved when her shunt was tied off in the neck. Her shunt was removed entirely six months later, and she has remained independent of her shunt.

Conclusions: In select patients with slit ventricle syndrome, a calvarial expansion may allow the arachnoid granulations to resume the absorption of cerebrospinal fluid.

116. Pediatric Neurosurgery Patients Need More than a Neurological Surgeon: A Clinical Experience

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Introduction: To explain how and why the Division of Pediatric Neurosurgery developed a comprehensive clinic for patient management.

Methods: The Division of Pediatric Neurosurgery of the University of Florida HSC Jacksonville performed a staged process to develop a comprehensive clinic for children with neurocognitive or physical disabilities, and/or speech impediment. Phase I: during the period 02/2006 and 01/2007 there was organizational planning, recruitment of health care personnel, and institutional support for the program. Phase II: In 04/2007 the first clinic was held at the Drew Bradbury Rehabilitation Center at Wolfson Children's Hospital, and subsequent monthly clinics have followed. Patient evaluation is by: pediatric neurosurgery, developmental pediatrics, clinic nurse coordinator, occupational therapy, physical therapy, speech therapy, and social services.

Results: This reports the activities of the period of 04/2007 to 06/2009. The clinic activity consisted of: Intake, Evaluation, Team Conference, Recommendations, and Care Plan Development. For those 18 years of age, the Transition Plan to the Adult Medical Home was initiated. There were 112 visits. The underlying neurosurgical conditions were: hydrocephalus (57); arachnoid cysts (5); brain tumors (4); head injury (3); and others (19). The results of the changes in healthcare needs for these patients will be discussed.

Conclusions: Children with a neurosurgical condition that require comprehensive patient management can benefit from multidisciplinary care. In the absence of such care, pediatric neurosurgeons can take the lead and facilitate the creation for such support in their community.

117. Intraosseous Lipoma of the Frontal Calvarium Mimicking Fibrous Dysplasia

Todd A. Maugans, MD; John Depowell, MD (Cincinnati, OH)

Introduction: Expansile lesions of the calvarium in young children are usual, with a well described, fairly brief list of possible pathologic entities described in the pediatric neurosurgical literature. Intraosseous lipomas have been described in childhood; however most are isolated to the appendicular skeleton.

Methods: A retrospective chart review was carried out to present this single case report of a child presenting with an expansile frontal calvarial lesion, including evaluation, management, and followup.

Results: A 32-month-old female presented with a bilateral expansion of the frontal calvarium, first noticed at approximately 3 months of age. Serial imaging confirmed an enlarging lesion, centered in the diploic space with remodeling of the inner and outer tables. Plain films, MR imaging, and radionuclide bone scan were felt diagnostic for fibrous dysplasia. Following near- total extirpation of a relatively hypovascular lesion, a cranioplasty was carried out. Pathological examination revealed benign intraosseous lipoma. At followup, the patient is evidencing excellent healing and cosmesis, without change in residual disease.

Conclusions: Intraosseous lipoma should be included in the differential diagnosis of enlarging pediatric skull lesions. Diagnostic imaging characteristics mimic fibrous dysplasia. Surgical extirpation is advised for enlarging lesions.

118. Cutaneous Vascular Malformations Associated with Spinal Dysraphism: Contemporary Reappraisal

Todd A. Maugans, MD (Cincinnati, OH)

Introduction: Cutaneous vascular lesions are frequently seen in association with both open and closed neural tube defects. Historically these been described as hemangiomas, however, they lack the requisite features of true hemangiomas: vascular proliferation with the ability to involute. A more proper nomenclature for vascularized cutaneous abnormalities seen in association with spinal column and spinal cord dysraphism would be "cutaneous vascular malformations."

Methods: A review of the literature, analysis of clinical observations, and preliminary histopathologic analysis of these lesions are presented.

Results: This literature review and data analysis provide insight into the pathogenesis and the embryology of cutaneous vascular malformations associated with neural tube defects.

Conclusion: These data underscore known interactions between neural plate, neural tube, neural crest, and paraspinal somites. Recent advances in histopathologic analysis of cutaneous vascular malformations offer promise for further understanding of these lesions.

119. Ventriculoperitoneal Shunt Ascites - Risk Factors Associated with Optic Chiasm- Hypothalamic Pilocytic Astrocytomas

Tukisa D. Smith, MS; Soumen Khatua, MD; J. Gordon McComb, MD; Mark Krieger, MD (Los Angeles, CA)

Introduction: Ventriculoperitoneal shunt (VPS) ascites is an uncommon complication in children with pilocytic astrocytomas (PAs) of the optic-chiasmatic hypothalamic pathway. This study aims to identify risk factors associated with shunt ascites in these patients.

Methods: This IRB-approved, 12-year retrospective study reviewed 12 cases of optic-chiasmatic hypothalamic PAs which required VPS (out of 111 PAs). Included were 7males and 5 females, ages 6 months-14 years (Mean 5.5years). Tumor location, age at diagnosis, age at VPS placement, resection type, history of multiple VPS revisions and tumor progression were evaluated for potential risk factors. Tumor volumes before first resection, at time of VPS placement and at presentation of ascites were assessed.

Results: 4/12 patients developed ascites, with 3/4 males. 3/4 had a history of multiple prior VPS revisions due to proximal shunt malfunction not complicated by ascites. All 4 patients had tumor progression, whereas only 2/8 patients without ascites had progression. 2/4 involved hypothalamic tumors, 1/4 was optic-chiasmatic, and 1/4 involved the optic chiasm and hypothalamus. Compared with the 8 patients who did not develop ascites, age at diagnosis was significantly different ($p=0.04$) with all patients under 4 years of age who had ascites. Age at time of VPS placement was not significant ($p=0.08$). Tumor volumes preoperatively and at time of VPS placement were not statistically significant ($p=0.11$ and 0.25 , respectively). Tumor volume at time of ascites was not statistically significant ($p=0.46$).

Conclusion: Presentation at an earlier age, history of multiple VPS revisions and tumor progression appear to be risk factors associated with the development of VPS ascites.

120. Shuntcheck, a Non-Invasive Device to Assess Ventricular Shunt Flow: One Institution'S Early Experience

Violette Renard Recinos, MD; Edward Ahn, MD; Benjamin Carson, MD; George Jallo, MD (Baltimore, MD)

Introduction: Hydrocephalus is a common neurosurgical problem often treated with ventriculoperitoneal shunt. Assessing shunt function involves clinical presentation, radiological findings and physical examination of the patient and the shunt reservoir, which often may include a shunt tap. ShuntCheck™ is a non-invasive transcutaneous thermal convection system that is used to detect cerebrospinal fluid (CSF) flow through shunts. In this study we have used ShuntCheck™ to evaluate patients with suspected shunt malfunction, and report our early findings.

Methods: Patients were screened per IRB protocol and enrolled in the study. Patients were evaluated with appropriate examination and radiological studies based on patient's history and presentation. ShuntCheck™ was used to assess shunt flow per trained protocol. Patients were followed for 7 days of the initial ShuntCheck™ test.

Results: Eight patients were enrolled in the study. Four of them had surgery to explore and revise the shunt; two had a ventricular catheter obstruction, two had poor flow through the valve or the peritoneal catheter. None of the patients had any adverse reactions to the ShuntCheck device. ShuntCheck accurately diagnosed poor flow in 100% of the operative cases. In one of the non-operative cases, ShuntCheck showed no flow, but a nuclear medicine study showed a patent shunt system.

Conclusions: Assessing patients for possible shunt malfunction involves a multimodal approach including clinical history, physical examination and radiological evaluation. ShuntCheck™ may prove a useful non-invasive tool to accurately assist in the shunt evaluation process, to help speed the diagnosis and potentially defer other more invasive diagnostic procedures.

POSTER ABSTRACTS

121. Technical Note: A Novel Bone-Cutting Instrument, the Bonescalpel, May be Useful in Performing Osteoplastic Laminoplasty

Violette Renard Recinos, MD; Edward Ahn, MD; George Jallo, MD (Baltimore, MD)

Introduction: Laminoplasty is a well described alternative to laminectomy in the treatment of certain spinal pathology. A novel device, the BoneScalpel by Misonix, is an ultrasonic osteotome that allows the surgeon to cut the bone while preserving the underlying soft tissue, potentially reducing the risk of dural laceration. In addition, it allows for very fine cuts as narrow as 0.5 mm. We used the BoneScalpel to perform osteoplastic laminoplasties in 2 patients undergoing surgery for spinal cord tumors and describe our preliminary findings.

Methods: Two patients who were undergoing planned laminoplasty for spinal cord tumors were brought to the OR and standard exposure of the appropriate lamina was carried out. In order to perform the laminoplasty, the BoneScalpel was used to cut troughs on either side of the lamina. The cut lamina were then disconnected rostrally and caudally from the posterior spinal ligament, and removed as one unit. Once the tumor resection was completed and dura closed, the bone was replaced with small bone plating systems.

Results: Successful laminoplasty was carried out in both cases. No known damage to the underlying soft tissue, dura or neural elements was identified.

Conclusions: The BoneScalpel is a potentially useful and safe device in performing osteoplastic laminoplasty. As it allows for a narrower trough than conventional drilling, less bone is ultimately removed. This could be especially useful in the pediatric population where the smaller defect in the approximated bone may lead to improved healing. Further studies should be carried out to explore this as a potential option.

122. Intracranial Meningiomas in Children: A Single-Institution Experience

Violette Renard Recinos, MD; Stanley Hoang, MS; Shaan Raza, MD; Kenneth Cohen, MD; Benjamin Carson, MD; George I. Jallo, MD; Peter Burger, MD; Edward Ahn, MD (Baltimore, MD)

Introduction: While meningiomas are one of the most common brain tumors found in adults, their occurrence in the pediatric population is rare, comprising only 0.4-4.1% of all pediatric age tumors, and approximately 1.5% of all intracranial tumors in children. In this study we reviewed our hospital's experience with intracranial pediatric meningiomas, and studied their clinical, radiological and pathological features and their relationship to patient outcomes.

Methods: We reviewed the case records from 1993 to 2009 and identified all pediatric patients who were diagnosed with an intracranial meningioma. Cases were reviewed for clinical presentation, location, and pathology, and tracked for follow-up and recurrence rate.

Results: Eight patients were identified with an intracranial meningioma, and all patients went on to have a surgical resection of their tumors. Two patients were diagnosed with neurofibromatosis, type 2. Five out of the eight patients were right sided tumors. Locations were sphenoid wing (25%), intraparenchymal (25%), anterior skull base (12.5%), convexity (12.5%) foramen magnum (12.5%), and intraventricular (12.5%). Pathology showed either atypical meningioma (12.5) or a MIB-1 rate that was higher than that of most grade I meningiomas in 50% of the cases. Three (37.5%) of the eight patients had a local recurrence requiring re-operation.

Conclusions: Meningiomas are uncommon in the pediatric population. Our series of eight patients identified 50% with a higher MIB-1 than WHO grade I tumors. Further investigation is needed to understand the particular characteristics of these tumors in the pediatric population.

123. Intramedullary Tumoral Calcinosis

Vivek Mehta, BS; Chetan Bettegowda, MD, PhD; George Jallo, MD (Baltimore, MD)

Introduction: Tumoral calcinosis (TC), a calcium hydroxyapatite based mass, is common in the extremities and hips, but has rarely been reported in the spine, and has never been reported within the spinal cord. It may occur sporadically, in familial form, or as a consequence of disorders that promote soft tissue calcification. Gross-total resection appears to be curative, but the diagnosis of TC is rarely considered prior to surgery. In this report, we describe the management of the first case of an intramedullary tumoral calcinosis located at the T5 level in a 20-month old African-American male who presented with lower extremity spasticity. Additionally, salient features of tumoral calcinosis diagnosis, radiologic patterns, histologic findings, treatment, and outcomes are discussed.

124. A Risk-adjusted Comparison of the Failure Rate of Endoscopic Third Ventriculostomy Performed in Sub-Saharan Africa versus Developed Nations

Abhaya V. Kulkarni, MD, PhD (Canada, Toronto); Benjamin C. Warf, MD (Boston, MA); James M. Drake, FRCS (Canada, Toronto); Conor L. Mallucci, FRCS (United Kingdom, Liverpool); Spyros Sgouros, FRCS (United Kingdom, Birmingham); Shlomi Constantini, MD, MSc (Israel, Tel Aviv)

Introduction: Endoscopic third ventriculostomy (ETV) is an important treatment for childhood hydrocephalus around the world. It is not known, however, whether the outcome of ETV is different in developed nations versus developing nations, once known prognostic factors are accounted for. That is, is there something inherently and appreciably different between what can be expected of ETV in developing nations compared to developed nations?

Methods: We analyzed a large cohort of children (≥ 20 years old) treated with ETV in developed nations (618 patients from Canada, Israel, United Kingdom) and developing nations of sub-Saharan Africa (979 patients treated in Uganda). Risk-adjusted survival analysis was performed.

Results: The risk of an intra-operative ETV failure (an aborted procedure) was significantly higher in Uganda regardless of risk-adjustment (hazard ratio [HR], 95% CI: 11.00 [6.01 to 19.84], $p < 0.001$). For ETV's that were completed, the risk of post-operative failure was higher in Uganda (HR, 95% CI: 1.20 [1.02 to 1.42], $p = 0.03$), when inherent population differences were not accounted for. However, after adjusting for age, etiology and the use of choroid plexus cauterization, there was no difference in the risk of post-operative failure for completed ETV's (HR, 95% CI: 1.04 [0.83 to 1.29], $p = 0.74$) between Uganda and developed nations.

Conclusions: Four factors account for all significant differences in ETV failure pattern between Uganda and developed nations: age, etiology, choroid plexus cauterization, and intra-operatively aborted cases. Once adjusted for these, the response to completed ETV's of children in Uganda appears no different than children in developed nations.

125. Using the ETV Success Score (ETVSS) to Determine Who Will Benefit from Endoscopic Third Ventriculostomy Compared to Shunt in Childhood Hydrocephalus

Abhaya V. Kulkarni, MD, PhD; James M. Drake, FRCS (Canada, Toronto); John R. Kestle, MD, MSc (Salt Lake City, UT); Conor L. Mallucci, FRCS (United Kingdom, Liverpool); Spyros Sgouros, FRCS (United Kingdom, Birmingham); Shlomi Constantini, MD, MSc (Israel, Tel Aviv)

Introduction: We previously developed the ETVSS, which is a simple scoring system that predicts the chances of ETV success for a child with hydrocephalus, based on age and etiology of hydrocephalus. The ETVSS ranges from 0 to 90 and roughly equals the percentage chance that an ETV will be successful (e.g., ETVSS=70 means a 70% predicted chance of ETV success). In this study, we compared the success of ETV to shunt, within strata of ETVSS (low, moderate, and high scores).

Methods: A multicenter, international cohort of children (≥ 19 years old) with newly diagnosed hydrocephalus treated with either ETV ($N=489$) or shunt ($N=647$) were analyzed. ETVSS was calculated for all patients and the cohort was divided into those with high ETVSS (score=80, $N=357$), moderate ETVSS (score=50-70, $N=384$), and low ETVSS (score=40, $N=395$). Survival analysis for time-to-treatment failure using Kaplan-Meier and Cox regression techniques was performed within each ETVSS group.

Results: In patients with a high ETVSS (score=80), ETV survival marginally outperformed shunt survival, although the difference was not significant ($p=0.1$). In the moderate ETVSS group (score=50-70), shunt survival was roughly equal to ETV survival ($p=0.11$). In the low ETVSS group (score=40), shunt survival was clearly superior to ETV survival at all time points ($p=0.008$).

Conclusions: Patients with low ETVSS ($=40$) not only have a low chance of success with ETV, but also significantly lower long-term success compared to shunt. Patients with high ETVSS ($=80$) experience equivocal benefit in treatment survival with ETV compared to shunt.

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NOTES

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This image shows a full page of blank handwriting practice paper. It features multiple sets of three horizontal lines each, designed to guide letter formation. Each set consists of a solid top blue line, a dashed middle green line, and a solid bottom red line. The sets are repeated down the entire length of the page, providing ample space for practicing cursive or other handwriting styles. There are no margins, titles, or other markings on the paper.

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2010 AANS/CNS Section on Pediatric Neurological Surgery Annual Meeting

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