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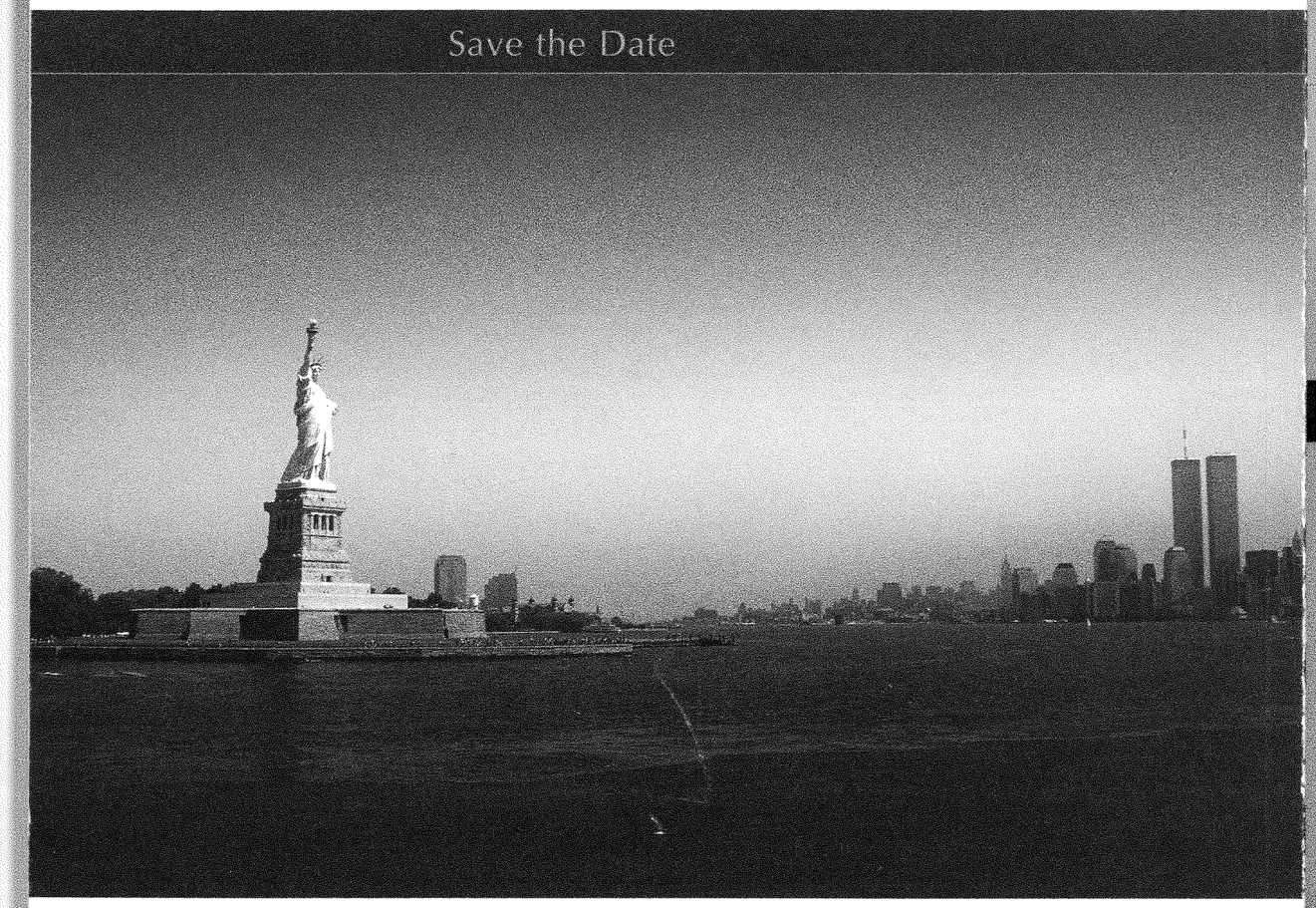

2001 AANS/CNS Section on Pediatric Neurological Surgery Annual Meeting in New York

November 28 – December 1, 2001
New York Marriott Marquis
New York, NY

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American Association of Neurological Surgeons

AANS/CNS Section on Pediatric Neurological Surgery
5550 Meadowbrook Drive
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Program Book

29th Annual Meeting of the American Association of Neurological Surgeons and Congress of Neurological Surgeons

December 6-9, 2000
Coronado (San Diego), California

Section on Pediatric Neurological Surgery

The Program Book was made possible, in part, by an educational grant provided by Radionics, a Division of Tyco Healthcare, Group LP.

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American Association of Neurological Surgeons

29th Annual Meeting
December 6-9, 2000
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Section on **Pediatric** Neurological Surgery

of the American Association of Neurological Surgeons
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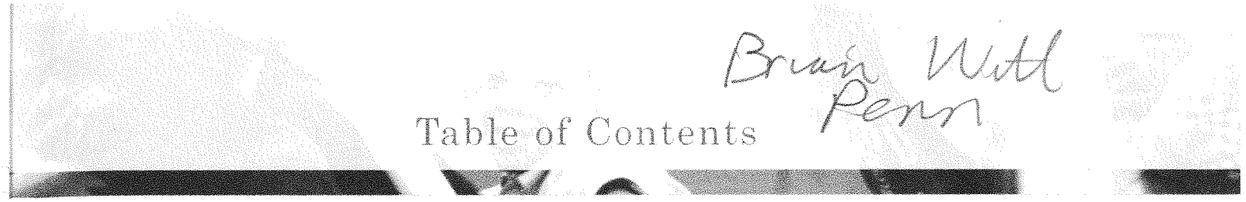

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Some drugs and medical devices demonstrated or described on the print publications of the AANS/CNS Section on Pediatric Neurological Surgery have a FDA clearance for use for specific purposes or for use only in restricted research settings. The FDA has stated that it is the responsibility of the physician to determine the FDA status of each drug or device he or she wishes to use in compliance with applicable law.

Continuing Medical Education Credit

This activity has been planned and implemented in accordance with the Essentials and Standards of the Accreditation Council for Continuing Medical Education (ACCME) through the joint sponsorship of the American Association of Neurological Surgeons and the AANS/CNS Section on Pediatric Neurological Surgery. The Accreditation Council accredits the American Association of Neurological Surgeons to sponsor continuing medical education for physicians.

The American Association of Neurological Surgeons designates this continuing education activity for 21 credit hours in category 1 toward the AMA Physician's Recognition Award and an additional 5 credit hours available for those attending the Nurse Seminar. Each physician should claim only those hours that he/she actually spent in the educational activity.

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 **Anne-Christine Duhaime:** The Shaken Baby Syndrome

1986 **Robert E. Breeze:** CSF Formation in Acute Ventriculitis

1987 **Marc R. DelBigio:** Shunt-Induced Reversal of Periventricular Pathology in Experimental Hydrocephalus

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

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

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

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

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

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

1994 **Ellen Shaver:** Experimental Acute Subdural Hemotoma in Infant Piglets

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

1996 **John Park, MD, PhD:** Platelet Derived Growth Factor Induces Differentiation of Neuroepithelial Stem Cells into Neurons

1997 **Michael J. Drewek, MD:** 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, MD:** The Surprisingly Sturdy Infant Brain: Why Is It More Resistant to Focal Injury?

2000 **TBA**

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 Hyrocephalus

1997 No prize awarded.

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

1999 **Kimberly D. Bingaman:** Hydrocephalus Induces the Proliferation of Cells in the Subventricular Zone

2000 **TBA**

Annual Winter Meeting Sites

1972	Cincinnati
1973	Columbus
1974	Los Angeles
1975	Philadelphia
1976	Toronto
1977	Cleveland
1978	Philadelphia
1979	New York
1980	New York
1981	Dallas
1982	San Francisco
1983	Toronto
1984	Salt Lake City
1985	Houston
1986	Pittsburgh
1987	Chicago
1988	Scottsdale
1989	Washington, D.C.
1990	San Diego & Pebble Beach
1991	Boston
1992	Vancouver, BC
1993	San Antonio
1994	St. Louis
1995	Pasadena
1996	Charleston
1997	New Orleans
1998	Indianapolis
1999	Atlanta
2000	Coronado
2001	New York
2002	Phoenix
2003	Miami

Pediatric Section Chairmen

1972-73	Robert L. McLaurin	**1983-85**	Harold J. Hoffman
1973-74	M. Peter Sayers	**1985-87**	William R. Cheek
1974-75	Frank Anderson	**1987-89**	David G. McLone
1975-76	Kenneth Shulman	**1989-91**	Donald H. Reigel
1976-77	E. Bruce Hendrick	**1991-93**	R. Michael Scott
1977-78	Frank Nulsen	**1993-95**	Arthur Marlin
1978-79	Luis Schut	**1995-97**	Harold L. Rekate
1979-81	Fred J. Epstein	**1997-99**	Marion L. Walker
1981-83	Joan L. Venes	**1999-2000**	John P. Laurent

Lecturers

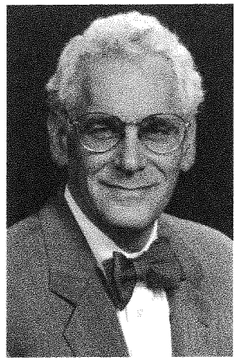
Matson Memorial Lecturers

1987	John Shillito	**1994**	Joseph Ranschoff
1988	E. Bruce Hendrick	**1995**	John Holter
1989	Martin P. Sayers	**1996**	
1990	Roger Guillemin	**1997**	Maurice Choux
1991	Robert L. McLaurin	**1998**	Lisa Shut
1992	Joseph Murray	**1999**	Gary C. Schoenwolf
1993	Eben Alexander, Jr.	**2000**	Postponed due to illness
		2001	Donald H. Reigel

Raimondi Lecturers

1978	E. Bruce Hendrick	**1989**	Martin Eichelberger
1979	Paul C. Bucy	**1990**	George R. Leopold
1980	Floyd Gilles	**1991**	Judah Folkman
1981	Panel Discussion	**1992**	Olof Flodmark
1982	Panel Discussion	**1993**	Maurice Albin
1983	Derek Harwood-Nash	**1994**	Blaise F.D. Bourgeois
1984	Anthony E. Gallo, Jr.	**1995**	Robert H. Pudenz
1985	Frank Nulsen	**1996**	Samuel S. Flint
1986	William F. Meacham	**1997**	M. Michael Cohen, Jr.
1987	Dale Johnson	**1998**	Robert A. Zimmerman
1988	Joseph J. Volpe	**1999**	David B. Schurtleff
		2000	Steve Berman

2000 Raimondi Lecturer



Steve Berman, MD

Steve Berman is a Professor of Pediatrics and Head of the Section of General Academic Pediatrics of the University of Colorado School of Medicine and The Children's Hospital. Steve and his wife, Elaine, have lived in Denver for 27 years and have two sons, Seth and Ben, in college. He is currently president-elect of the American Academy of Pediatrics and has served as the Academy state chapter Vice President and President. While chairperson of the national Academy Committee on Child Health Financing, he co-authored AAP policy statements on child health financing, scope of benefits, managed care, Medicaid, medical necessity, and Title XXI. Dr. Berman received his BA from Wesleyan University, Connecticut, and his MD from Temple University Medical School. He completed his internship and residency in Pediatrics at the University of Colorado Health Sciences Center, Denver.

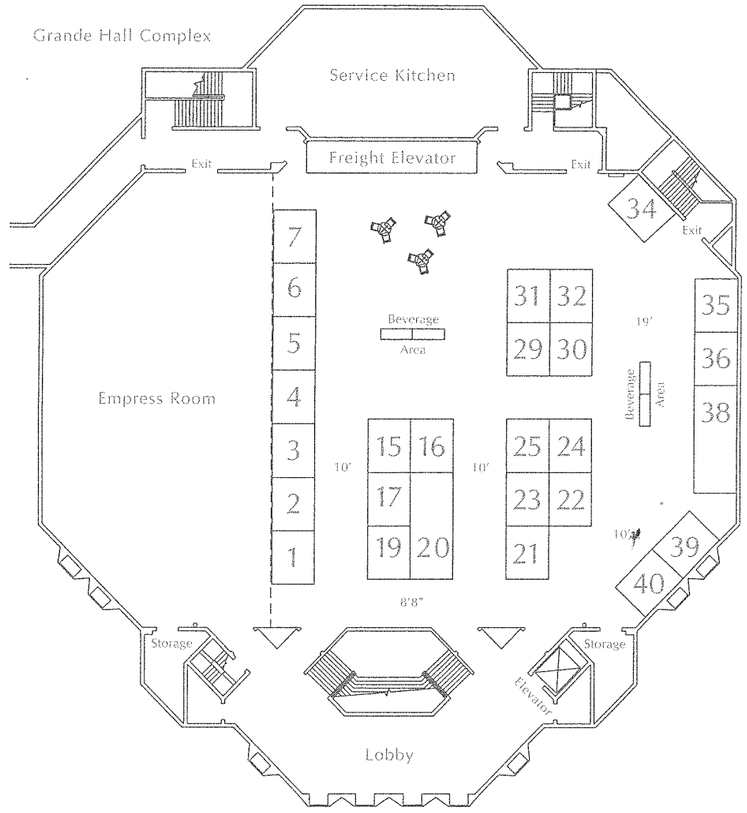
A practicing primary care pediatrician, Steve currently provides primary care for children with special health care needs and is a leader in child advocacy and community service. Steve has advocated for children as well as practicing pediatricians by working with State agencies as well as health insurance plans to improve access for underserved children and enhance the quality of pediatric services. He was a founding member of the Colorado Children's Campaign and has authored six child health bills enacted by the Colorado State legislature. These laws provide health insurance to low-income children (Colorado Child Health Plan), require seat belt use, and mandate immunizations and preventive care in insurance plans. He helped develop several successful community service projects. These include the Reach Out project to increase the participation of private practice physicians in programs that serve low-income underserved children; the Mile High Healthy Beginnings project to provide medical services to children enrolled in subsidized child care centers; and the Bright Beginnings statewide project to promote child development during the first three years of life.

He has worked in migrant health centers, community health centers and hospital clinics in the United States and in South America. The World Health Organization has recognized his contributions related to primary care and managing acute respiratory infections. The program he designed has been implemented in more than 80 developing countries. Steve's commitment to clinical practice resulted in authoring three textbook editions of pediatric algorithms entitled Pediatric Decision Making as well as many chapters in other pediatric textbooks and journal articles. His clinical research projects have focused on common pediatric problems such as otitis media and immunizations. Currently, he directs a CDC sponsored Colorado Rural Immunization Services Project (CRISP).

Steve is a respected educator who developed one of the country's first pediatric primary care residency training programs in Denver. He received a University of Colorado Innovation in Education Award for developing Internet training materials. He also designed a successful three-year primary care medical student course, initiated a medical student AAP Pediatric Club and has assisted medical students and pediatric residents in developing community service projects.

Exhibit Hall Floor Plan

Hotel Del Coronado
San Diego, California



Exhibitor Listing

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

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Acton, MA 01720
(978) 263-9186

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5550 Meadowbrook Drive
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(847) 378-0500

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Lynn, MA 01902
(781) 592-7200

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Redwood City, CA 94065
(650) 494-7240

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One Zeiss Drive
Thornwood, NY 10594
(800) 442-4020

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2275 East Bayshore Road, Suite 101
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(650) 842-1800

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Compass International, Inc. — **Booth 31**
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919 37th Avenue NW
Rochester, MN 55901
(507) 281-2143

Hydrocephalus Association — **Booth 3**
870 Market Street, Suite 705
San Francisco, CA 94102
(415) 732-7040

Integra Neurosciences — **Booth 22**
105 Morgan Lane
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(609) 275-0500

KLS-Martin, LP — **Booth 40**
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Jacksonville, FL 32250
(904) 641-7746

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Allendale, NJ 07401
(800) 526-0355

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(817) 788-6400

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(763) 514-5000

Medtronic PS Medical — **Booth 38**
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(888) 580-8860

Moller Microsurgical — **Booth 32**
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Mason, OH 45040
(513) 336-7255

NMT Neurosciences — **Booth 19**
3450 Corporate Way, Suite A
Duluth, GA 30096
(678) 282-0542

Phoenix Biomedical Corp. — **Booth 29**
2495 General Armistead Avenue
Norristown, PA 19403
(610) 539-9300

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29th Annual Meeting of the AANS/CNS Section on Pediatric Neurological Surgery

December 6–9, 2000
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George T. Burson, MD	T. Glenn Pait, M.D., Consultant: Medtronic, Sofamor Danek, Johnson & Johnson, DePuy AcroMed
John J Collins, MD	John J. Collins is an unpaid clinical consultant to Voxel with no financeal connection. Raymond Schulz, Michael Dalton and Stephen Hart are employees of Voxel with shares of stock in the company.
Mark S. Dias, MD, FAAP	Sponsored by a grant from the William B. Hoyt Memorial Children and Family Trust Fund, Office of Children and Family Services of New York State
Daniel Y. Suh, MD, PhD	GE Medical Systems, Inc., Lloyd Estkowski, Applications Development Specialist, has provided the software to generate the ADC (apparent coefficient) maps.

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Mei Wong, MD
Charles J. Wrobel, MD
Shinya Yamada, MD
Andrew S. Youkilis, MD

Learning Objectives

Nurses' Seminar

The participant should be able to:

- ☐ recognize current treatment practices for pediatric brain tumors and in utero closures of myelomeningocele.
- ☐ identify current research trends in hydroceophalus. and pain in children.

Scientific Session I—Perinatal Neurosurgery

The participant should be able to:

- ☐ assess prenatal imaging.
- ☐ apply prenatal counseling strategies.

Scientific Session II—Neurosurgery of Infancy and Childhood

The participant should be able to:

- ☐ recognize congenital neurosurgical conditions.
- ☐ manage congenital neurosurgical anomalies.

Wednesday, December 6, 2000

11:00 am – 5:00 pm	Speaker Preview Room—**Board Room**
12:00 Noon – 5:00 pm	Nurses' Seminar*—**Spreckels Complex**
2:00 pm – 8:00 pm	Registration—**Grande Hall Foyer**
6:00pm – 8:00 pm	Opening Reception with Exhibitors in the Grande Hall of the Hotel del Coronado—**Regent/Viceroy Rooms**

Thursday, December 7, 2000

7:00 am – 5:00 pm	Speaker Preview Room—**Board Room**
7:00 am – 6:00 pm	Registration—**Grande Hall Foyer**
7:00 am – 9:00 am	Continental Breakfast with Exhibit Viewing—**Regent/Viceroy Rooms**
7:00 am – 11:00 am	Poster Setup for Medical Registrants—**Grande Hall Lower**
7:00 am – 12:00 pm	**Exhibit and Poster Viewing Hours—Regent/Viceroy Rooms & Grande Hall Lower**
1:30 pm – 5:30 pm	**Exhibit and Poster Viewing Hours—Regent/Viceroy Rooms & Grande Hall Lower**
8:00 am – 11:00 am	Spouse/Guest Hospitality—**Coastal/Surf Rooms**
8:00 am – 8:05 am	Welcoming and Opening Remarks—**Empress Room**
8:05 am – 9:45am	Scientific Session I—Perinatal Neurosurgery* Prenatal Counseling: Case Presentations and Panel Discussions—**Empress Room** Moderator: H. E. James, MD Panelists: K.L. Jones, MD – G. Leopold, MD – A. Scioscia, MD – L. Sutton, MD – R. A. Zimmerman, MD
9:45 am – 10:15 am	Refreshments, Snacks and Exhibit Viewing—**Regent/Viceroy Rooms**
10:15 am – 12:00 pm	Scientific Session II—Neurosurgery of Infancy and Childhood*—**Empress Room** Moderators: D. G. McLone, MD – W. J. Oakes, MD
10:15 am – 10:25 am	**1. Intrauterine Myelomeningocele Repair: An Update** Noel B. Tulipan, MD; Joseph P. Bruner, MD (Nashville,TN)
10:25 am – 10:35 am	**2. Understanding Oligodendrocyte Loss Following Perinatal Ischemia** Shenandoah Robinson, MD, Kasia Petelenz, BA (Cleveland, OH) and Robert H. Miller, PhD (Cleveland, OH)
10:35 am – 10:45 am	**3. Anterograde Trophic Support to the Developing Striatum: Role of Glutamatergic Afferents** Sandeep Mittal, MD, M. A. Alonso-Vanegas, MD (Montreal, PQ), R. Aloyz, PhD (Montreal, PQ), F.D. Miller, PhD (Montreal, PQ), A. F. Sadikot, MD, PhD (Montreal, PQ)

* Please see Learning Objectives above.

Learning Objectives

Poster Discussion I

The participant should be able to:

- ☐ evaluate case management strategies.
- ☐ apply treatment options.

Scientific Session III—Neurosurgery of Infancy and Childhood

The participant should be able to:

- ☐ recognize congenital neurosurgical conditions.
- ☐ manage congenital neurosurgical anomalies.

Thursday, December 7, 2000 continued

10:45 am – 10:55 am	**4. Magnetic Resonance Study of Ventricular Dilatation and CSF Drainage in an Acute Reversible Hydrocephalic Guinea Pig Model** Shinya Yamada, MD, Masayoshi Shibata (Los Angeles), Miriam Scadeng (Los Angeles), Stefan Bluml (Los Angeles), Catherine Nguy (Los Angeles), Brian D. Ross (Los Angeles), J. G. McComb, MD (Los Angeles)
10:55 am – 11:05 am	**5. Magnetic Resonance (MR) Spectroscopic Changes in Pediatric Patients with Acute Hydrocephalus, Hydrocephalus and Cortical Atrophy** Miriam Scadeng, MD, Rex A. Moats, Marvin D. Nelson, Jr., Michael L. Levy, MD, J. Gordon McComb, MD (Los Angeles)
11:05 am – 11:15 am	**6. Comparison of Subgaleal Shunts and Ventricular Reservoirs in the Initial Management of Post-Hemorrhagic Hydrocephalus in Premature Infants** Christopher A. Gegg, MD, Dale M. Swift, MD (Dallas, TX)
11:15 am – 11:25 am	**7. Ten Children with Coccidioidomycosis Meningitis: Clinical Presentation, Treatment, and Long Term Prognosis** Charles J. Wrobel, MD, Kevin Taubman, MD (Bakersfield, CA)
11:25 am – 11:35 am	**8. Does Cine MRI (CMRI) Help Predict Favorable Outcome or Symptoms in Children with Chiari I Malformations (CIM)?** Ann M. Ritter, MD, William Frawley, PhD (Dallas, TX), Katie Dominquez, PA (Dallas, TX), Nancy Rollins, MD (Dallas, TX), Dale M. Swift, MD (Dallas, TX), Derek Bruce, MD (Dallas, TX).
11:35 am – 11:45 am	**9. Outcome of Scoliosis After Chiari Decompression** Michael H. Handler, MD, F.A.C.S., F.A.A.P., James M. Eule, MD, Patti Batchelder, RN, MSN, Mark A. Erickson, MD, Michael O'Brien, MD
11:45 am – 11:55 am	**10. Craniocervical Instability in Patients with Mucopolysaccharidosis, Review of 30 Cases** Essam A. Al Shail, MD, BS, Abdulsattar Ghomraoui, MD (Riyadh, Saudi Arabia), Pinar Ozand, MD (Riyadh, Saudi Arabia)
12:00 pm - 1:30 pm	**Luncheon Poster Sessions—Grande Hall Lower**
1:30 pm – 2:15 pm	Poster Discussion I*—**Empress Room** Moderators: R. Abbott, MD – D. G. McLone, MD
2:15 pm – 3:05 pm	Scientific Session III—Neurosurgery of Infancy and Childhood (continued)*—**Empress Room** Moderators: R. P. Humphreys, MD – L. Sutton, MD
2:15 pm – 2:25 pm	**11. Predicting the Risk of Stroke in MoyaMoya Disease Using XenonCT** David J. McAuley, MD, FRCS, Ken Poskitt, MDCM (Vancouver, BC), Paul Steinbok, MD, FRCSC (Vancouver, BC)
2:25 pm – 2:35 pm	**12. Complex Reconstruction/Bypass Versus Trapping in Giant Intracranial Aneurysms in Children and Adolescents** Michael L. Levy, MD, Larry Khoo, MD (Los Angeles, CA) J. Gordon McComb, MD (Los Angeles, CA)

* Please see Learning Objectives above.

Learning Objectives

Scientific Session IV—Neoplasms

The participant should be able to:

- ☐ recognize current treatment and protocols for brain tumors.
- ☐ analyze therapeutic options for CNS neoplasms.

Thursday, December 7, 2000 continued

2:35 pm – 2:45 pm
13. Endovascular Management of Pediatric Lesions
Indro Chakrabarti, MD, Arun P. Amar, MD (Los Angeles, CA) Michael L. Levy, MD (Los Angeles, CA) Don Larsen, MD (Los Angeles, CA) J. Gordon McComb, MD (Los Angeles, CA) George P. Teitelbaum, MD (Los Angeles, CA)

2:45 pm – 2:55 pm
14. Surgical Treatment of Spinal Arteriovenous Malformations in the Pediatric Population
Howard A. Riina, MD, Nicholas Theodore, MD (Phoenix, AZ), Jonathan Hott, MD (Phoenix, AZ), Harold L. Rekate, MD (Phoenix, AZ), Robert F. Spetzler, MD (Phoenix, AZ)

2:55 pm – 3:05 pm
15. Stereotactic Radiosurgery for Pediatric Intracranial Arteriovenous Malformations
Matthew D. Smyth, MD, Elaine Park, RN (San Francisco, CA), Penny K. Sneed, MD (San Francisco, CA), Michael Lawton, MD (San Francisco, CA), Michael W. McDermott, MD (San Francisco, CA)

3:05 pm – 3:30 pm Refreshment, Snacks and Exhibit Viewing—**Regent/Viceroy Rooms**

3:30 pm – 5:00 pm Scientific Session IV—Neoplasms*—**Empress Room**
Moderators: R. A. Sanford, MD – J. H. Wisoff, MD
Panelists: TBA

3:30 pm – 3:40 pm
16. Growth Rate of Vestibular Schwannomas in Neufibromatosis Tyoe-2 early in Life
Sebastian Thomas, MD, Cordula Matthies, MD (Hannover, Germany), Katja Kniese, MD (Hannover, Germany), Marcos Tatagiba, MD (Hannover, Germany), Madjid Samii, MD (Hannover, Germany)

3:40 pm – 3:50 pm
17. Salvage Therapy after Relapse in Medulloblastoma
Stephen L Huhn, MD, Paul G. Fisher, MD (Stanford, CA), Quynth Le, MD (Stanford, CA), William Wara, MD (San Francisco, CA), Kathleen Lamborn (San Francisco, CA), Rhonda Zachary, MD (San Francisco, CA), Tress L. Goodwin (Stanford, CA), Michael D. Prados, MD (San Francisco, CA)

3:50 pm – 4:00 pm
18. Giant Cell Glioblastoma of Pediatric Population: A Study of Eighteen Cases
Indro Chakrabarti, MD, Sooho Choi, MD (Los Angeles, CA), Michael L. Levy (Los Angeles, CA), Floyd H. Gilles (Los Angeles, CA), J. Gordon McComb (Los Angeles, CA)

4:00 pm – 4:10 pm
19. Pediatric Ependymoma (40 in 36 months)
Renetta J. Osterdock, MD, Robert A Sanford, MD (Memphis, TN), Thomas E Merchant, DO, PhD (Memphis, TN)

4:10 pm – 4:20 pm
20. Brainstem Gliomas: A 10-Year Institutional Review
Farmer Jean-Pierre, MD, CM, FRCS(c), José Luis Montes (Montréal, Canada), Carol R. Freeman (Montréal, Canada), Mason C. Bond (Montréal, Canada), Kathleen Meagher-Villemure (Lausanne, Switzerland), Augustin M. O'Gorman (Montréal, Canada)

* Please see Learning Objectives above.

Learning Objectives

Scientific Session V—Craniosynostosis and Craniofacial Anomalies

The participant should be able to:

- ☐ assess the value of reabsorbable cranial materials.
- ☐ apply new reconstructive techniques.

Thursday, December 7, 2000 continued

4:20 pm – 4:30 pm
21. Management of Thalamic Tumors in Children
George I. Jallo, MD, Diana Freed, MS (New York, NY), Fred Epstein, MD (New York, NY)

4:30 pm – 4:40 pm
22. Diabetes Insipidus and Serum Sodium in the Perioperative Period of Craniopharyngioma Resection
Cynthia M Cupido, MD, L. Dalle Mulle1, MD, M. Halperin, MD, J. Blount, MD, D. Bohn, MD (Toronto, Ontario, Canada)

4:40 pm – 4:50 pm
23. Pediatric Craniopharyngioma; Long Term Follow up Following Aggressive Surgical Resection
Jeffrey P. Blount, MD, Flavio Pulera, MD, Cynthia Cupido, MD, Patricia Rowe, RN, Tina Popov, RN, CPNP, H. J. Hoffman, MD, R. P. Humphreys, MD, J. T. Rutka, MD, P. B. Dirks, MD, J. M. Drake, MD (Toronto, Ontario, Canada)

5:00 pm – 6:00 pm **Annual Business Meeting—Empress Room**

Friday, December 8, 2000

7:00 am – 5:00 pm Registration—**Grande Hall Foyer**

7:00 am – 5:30 pm Speaker Preview Room—**Board Room**

7:00 am – 9:00 am Continental Breakfast with Exhibit Viewing—**Regent/Viceroy Rooms**

7:00 am – 12:00 pm **Exhibit and Poster Viewing Hours—Regent/Viceroy Rooms & Grande Hall Lower**

1:30 pm – 5:30 pm **Exhibit and Poster Viewing Hours—Regent/Viceroy Rooms & Grande Hall Lower**

8:00 am – 11:00 am Spouse/Guest Hospitality—**Coastal/Surf Rooms**

8:00 am – 9:00 am Scientific Session V—Craniosynostosis and Craniofacial Anomalies*—**Empress Room**
Moderators: D. A. Bruce, MD – A. M. Flannery, MD

8:00 am – 8:10 am
24. Aprotinin: A Pharmacologic Therapy that Reduces Blood Loss in Craniofacial Surgery
Karin M. Muraszko, MD, Steven R. Buchman, MD (Ann Arbor, MI), Hamish M. Munro, MD (Ann Arbor, MI), Laurie J. Stricker, MD (Ann Arbor, MI)

8:10 am – 8:20 am
25. Multiple Revolution Spiral Osteotomy for Cranial Reconstruction; Surgical Technique and Early Results in Ten Patients.
Matthew N. Henry, MD, Micam Tullous, MD (San Antonio, TX), Patricia Mancuso, MD (San Antonio, TX), Dennis Vollmer, MD (San Antonio, TX) Nitin Tandon, MD (San Antonio, TX)

8:20 am – 8:30 am
26. Endoscopic Assisted verses Open Strip Craniectomy for Sagittal Craniosynostosis: A Retrospective Review
Donnie T. Tyler II, MD, Andrew Parent, MD (Jackson, Mississippi)

* Please see Learning Objectives above.

Learning Objectives

Scientific Session VI—Hydrocephalus

The participant should be able to:

- ☐ evaluate the use of shunt procedures.
- ☐ recognize the value of treatment options for hydrocephalus.

Friday, December 8, 2000 continued

8:30 am – 8:40 am

27. Sagittal Craniosynostosis Outcome Assessment for Two Methods and Timings of Intervention
Paul C. Francel, MD, PhD, Jayesh Panchal, MD (Dept of Plastic Surgery, Oklahoma City, OK), J. L. Marsh, MD (St. Louis, MO), T. S. Park, MD (St. Louis, MO), B. Kaufman, MD (St. Louis, MO), T. Pilgram, PhD (St. Louis, MO), S. H. Huang, (St. Louis, MO)

8:40 am – 8:50 am

28. Cortical Dysmorphology in Non-syndromic Craniosynostosis
Benjamin C. P. Lee, MD, Mokhtar Gado, MD, (Saint Louis, MO), T. S. Park, MD, (Saint Louis, MO)

8:50 am – 9:00 am

29. Developmental Delays in Children with Non-Syndromic Craniosynostosis and Deformational Plagiocephaly
Paul C. Francel, MD, PhD, Hamid Amirsheybani, MD (Oklahoma City, OK), Robin Gurwitch, PhD (Oklahoma City, OK), Vicki Cook, MEd (Oklahoma City, OK), Jayesh Panchal, MD (Oklahoma City, OK), Barbara Neas, PhD (Oklahoma City, OK), Norman Levine, MD (Oklahoma City, OK)

9:10 am – 10:00 am Scientific Session VI—Hydrocephalus*—**Empress Room**
Moderators: P. Steinbok, MD – J. G. McComb, MD

9:10 am – 9:20 am

30. Surveillance CT Scans in Routine Shunt Evaluation
Scott W. Elton, MD, R. Shane Tubbs, MS, PA-C (Birmingham, AL), Paul A. Grabb, MD (Birmingham, AL), W. Jerry Oakes, MD (Birmingham, AL)

9:20 am – 9:30 am

31. The Application of Controlled, Iatrogenic Intracranial Hypertension in Slit Ventricle Syndrome Patients with Shunt Malfunction
William E. Butler, MD, Saad Khan (Montréal, Quebec, Canada), Paul H. Chapman, MD (Boston, MA)

9:30 am – 9:40 am

32. Infection Rates in the Treatment of Loculated Hydrocephalus with Endoscopic Fenestration
Renatta J. Osterdock, MD (Memphis, TN), Stephanie L. Einhaus, MD (Memphis, TN), Michael Muhlbauer, MD (Memphis, TN), Frederick Boop, MD (Memphis, TN), Robert A. Sanford, MD, (Memphis, TN)

9:40 am – 9:50 am

33. Death Following Delayed Failure of Third Ventriculostomy: A Report of 3 Cases.
Walter J. Hader, MD, FRCS(c), Jim Drake (Toronto, Ontario, Canada), Doug Cochrane (Vancouver, BC, Canada), John Kestle (Salt Lake City, UT), Owen Sparrow (England)

9:50 am – 10:00 am

34. Long-term Control of Hydrocephalus Associated with Presumed Benign Gliomas of the Midbrain by Endoscopic Third Ventriculostomy
Curtis J. Rozzelle, MD, Paul A. Grabb, MD

* Please see Learning Objectives above.

Learning Objectives

Scientific Session VII—Topics and Advances in Pediatric Neurosurgery

The participant should be able to:

- ☐ recognize the value of diagnostic techniques.
- ☐ formulate treatment strategies.

Friday, December 8, 2000 continued

10:00 am – 10:30 am Refreshments, Snacks and Exhibit Viewing—**Regent/Viceroy Rooms**

10:30 am – 12:00 pm Scientific Session VII—Topics and Advances in Pediatric Neurosurgery*—**Empress Room**
Moderators: S. Gaskill, MD – P. H. Cogen, MD

10:30 am – 10:40 am

35. Novel Findings in the Development of the Normal and Tethered Filum Terminale
Ketan R. Bulsara, MD†, Thomas J. Cummings, MD, Roger E. McLendon, MD, Herbert E. Fuchs, MD, Timothy M. George, MD (Durham, NC)

10:40 am – 10:50 am

36. The Relationship of Malformation Anatomy to Deterioration Patterns in Patients with Transitional Lipomyelomeningocele
David D. Cochrane, MD, FRCS(c), Christian Finley, MD, John Kestle, MD, Paul Steinbok, MBMS (Vancouver, BC Canada)

10:50 am – 11:00 am

37. Split-Cord Malformations Associated with Distal Tethering in Children. is Untethering Indicated?
David Hart, MD, Hulda Magnadottir, MD (Lebanon, NH), Mark Krieger, MD (New York, NY), J. Gordon McComb, MD (Los Angeles, CA), Michael L. Levy, MD (Los Angeles, CA)

11:00 am – 11:10 am

38. The Tethered Cord Syndrome: Urodynamic Evidence of Improved Outcome with Early Untethering
Andrew S. Youkilis, MD, Hong Jin Suh, MD† (Ann Arbor, MI), Harry Koo, MD (Ann Arbor, MI), David A. Bloom, MD (Ann Arbor, MI), Karin Muraszko, MD (Ann Arbor, MI)

11:10 am – 11:20 am

39. The Natural History of Tethered Cord in Patients with Myelomeningocele
Loi K. Phuong, MD, Corey Raffel, MD (Rochester, MN), Kimberly Schoeberl, RN (Rochester, MN)

11:20 am – 11:30 am

40. Reliability of Intraoperative Electrophysiological Monitoring in Selective Posterior Rhizotomy
Sandeep Mittal, MD, Jean-Pierre Farmer, MD (Montréal, PQ), Chantal Poulin, MD (Montréal, PQ), Kenneth Silver, MD (Montréal, PQ)

11:30 am – 11:40 am

41. Long Term Functional Outcome for Children Treated with Selective Dorsal Rhizotomy for Spasticity
Shabbar Danish, BS, Susan Guzzardo, PT (New York, NY), Linda Velasquez, MS (New York, NY), I. R. Abbott, MD (New York, NY)

11:40 am – 11:50 am

42. Operative Complication Rate of Baclofen Pump Therapy in Pediatric Patients: Results of 48 Patients Followed at a Single Center.
Nathan C. Avery, MD, Marion L. Walker, MD (Salt Lake City, UT)

11:50 am – 12:00pm

43. Subfascial Implantation of Intrathecal Baclofen Pumps in Children
Howard L. Weiner, MD, Brian Harris Kopell, MD (New York, NY), Debra A. Sala, MS, PT (New York, NY)

* Please see Learning Objectives above.

Learning Objectives

Poster Discussion II

The participant should be able to:

- ☐ identify case management strategies.
- ☐ apply treatment options.

Scientific Session VIII—Trauma

The participant should be able to:

- ☐ recognize and manage children with injuries.

Friday, December 8, 2000 continued

12:00pm – 1:00 pm **Luncheon Poster Sessions—Grande Hall Lower**

1:00 pm – 1:45 pm Poster Discussion II*—**Empress Room**
Moderators: J. Wisoff, MD – M. S. Edwards, MD

1:30 pm – 4:00 pm Poster Removal—**Grande Hall Lower**

2:00 pm – 3:00 pm Raimondi Lecture 2000—**Empress Room**
Steve Berman, MD, FAAP

3:00 pm – 3:30 pm Refreshments, Snacks and Exhibit Viewing—**Regent/Viceroy Rooms**

3:30 pm – 5:10 pm Scientific Session VIII—Trauma—**Empress Room**
Moderators: R. M. Scott, MD – T. G. Luerssen, MD

3:30 pm – 3:40 pm **44. A Targeted Program of Parent Education at the Time of a Child's Birth can Significantly Reduce the Incidence of Shaken Baby Syndrome: The Western New York Experience**
Mark S. Dias, MD†, FAAP, Paula Mazur, MD, FAAP (Buffalo, NY), Veetai Li, MD (Buffalo, NY)

3:40 pm – 3:50 pm **45. NonAccidental Pediatric Head Trauma: Diffusion Weighted MRI Findings**
Daniel Y. Suh, MD†, PhD, Patricia Davis, MD (Atlanta, GA), Kara Hopkins, MD (Atlanta, GA), Nancy Fajman, MD (Atlanta, GA), Timothy Mapstone, MD (Atlanta, GA)

3:50 pm – 4:00 pm **46. A Prospective Study of an Out-Patient Management Scheme for Children with Minor Head Injuries (GCS 13-15) and No Radiographically Visible Intracranial Injuries**
Mark S. Dias, MD†, FAAP, Kathleen A. Lillis, MD, FAAP (Buffalo, NY), Carmen Calvo, MD (Buffalo, NY), Veetai Li, MD (Buffalo, NY)

4:00 pm – 4:10 pm **47. Decompressive Craniectomy- the Second- Tier Therapy of Choice in the Treatment of Uncontrollable Post-traumatic Intracranial Hypertension in Children?**
Waltraud Kleist-Welch Guerra, MD, Michael R. Gaab, MD, PhD, Clinic of Neurosurgery, Ernst-Moritz-Arndt-University, Greifswald, Wolfgang Wagner, MD, Clinic of Neurosurgery, Ernst-Moritz-Arndt-University, Greifswald

4:10 pm – 4:20 pm **48. Neurologic Ski Injuries in Children: Morbidity Assessment and the Impact of Ski Helmet Use in a Study of Skiing Children**
John B. Harris, MD

4:20 pm – 4:30 pm **49. Variability in the Definition and Treatment of SCIWORA: A Survey of Pediatric Neurosurgeons**
Mei Wong, MD, Mark S. Dias, MD†, FAAP (Buffalo, NY), Veetai Li, MD (Buffalo, NY)

4:30 pm – 4:40 pm **50. A Prospective Study of the Utility of MRI in the Diagnosis and Treatment of Transient Neurologic Deficits Following Spinal Cord Injury in Children**
Susan R. Durham, MD, Albert Telfeian, MD (Philadelphia, PA), John Boockvar, MD (Philadelphia, PA), Peter Sun, MD (Oakland, CA)

* Please see Learning Objectives above.

Learning Objectives

Scientific Session IX—New Millennium: New Ideas

The participant should be able to:

- ☐ aquire knowledge of technical advances in neurosurgery.

Friday, December 8, 2000 continued

4:40 pm – 4:50 pm **51. MRI Clinical Correlation in Spinal Cord Injury Without Radiographic Abnormality in Children.**
Amos O. Dare, MD, Veetai Li, MD (Buffalo, NY), Mark S. Dias, MD† (Buffalo, NY)

4:50 pm – 5:00 pm **52. Avulsion Transverse Ligament Injuries in Children: Successful Treatment with Non-Operative Management**
Patrick Lo, MD, BSc(Med), FRACS, Peter Dirks, MD (Toronto, Ontario, Canada), James Drake, MD (Toronto, Ontario, Canada), Douglas Hedden, MD (Toronto, Ontario, Canada)

5:00 pm – 5:10 pm **53. Does Congenital Cervical Spinal Stenosis Contribute to Sports-Related Transient Neurologic Deficits in Children?**
Susan R. Durham, MD, John Boockvar, MD (Philadelphia, PA), Peter Sun, MD (Oakland, CA)

5:15 pm – 5:55 pm Scientific Session IX—New Millennium: New Ideas*—**Empress Room**
Moderators: H. L. Rekate, MD, J. P. Laurent, MD

5:15 pm – 5:25 pm **54. Analysis of Intra-Cranial Pressure During Invasive Monitoring of Children with Medically Intractable Seizures**
Karsten Fryburg, MD, Yong Park, MD, Jack Yu, MD, John Vender, MD, Mark Lee, MD, PhD

5:25 pm – 5:35 pm **55. Hemispherectomy in Older Children with Rassmussen's Disease**
Alan T. Villavicencio, MD, Michael Haglund, MD, PhD (Durham, NC), Daryl Lewis, MD, (Durham, NC), Rodney Radtke, MD (Durham, NC), Richard Morse, MD (Durham, NC), Ketan Bulsara, MD† (Durham, NC), Timothy M. George, MD (Durham, NC)

5:35 pm – 5:45 pm **56. The Use of Intraoperative MRI for the Treatment of Pediatric Tumors**
Todd W. Vitaz, MD, Thomas Moriarty, MD, PhD (Louisville, KY), Stephen Hushek, PhD (Louisville, KY), Christopher B. Shields, MD (Louisville, KY)

5:45 pm – 5:55 pm **57. The Integration of Real-time Functional MRI in Pediatric Brain Tumor Resection**
John C. Wellons, III, MD, J. C. Leveque, BA (Durham, NC), Matt McGirt, BA (Durham, NC), Jeffrey Petrella, MD (Durham, NC), James Voyvodic, PhD (Durham, NC), Herbert Fuchs, MD, Michael Haglund, MD, PhD, Timothy George, MD (Durham, NC)

6:30 pm – 7:30 pm **Annual Reception—Coronet Room, Hotel del Coronado**

7:30 pm – 11:00 pm **Annual Banquet—Crown Room, Hotel del Coronado**

* Please see Learning Objectives above.

Scientific Program

Learning Objectives

Practice Management and CPT Coding and Billing for Pediatric Neurosurgery

The participant should be able to:

- ☐ recognize potential risk factors that can cause an OIG audit.
- ☐ apply coding fundamentals related to E & M coding, the Global Surgical Package and modifiers.

Optional Meeting Extension—"My Shunting is Better than Yours"

The participant should be able to:

- ☐ compare and contrast different shunt systems.
- ☐ identify the best shunt systems for their practice.

Saturday, December 9, 2000

7:00 am – 12:00 noon	Registration for Practice Management—**Grande Hall Foyer**
7:00 am – 9:00 am	Continental Breakfast with Exhibit Viewing—**Regent/Viceroy Rooms**
7:00 am – 11:00 am	**Exhibit Viewing Hours—Regent/Viceroy Rooms**
7:30 am – 7:30 pm	Speaker Preview Room—**Board Room**
8:00 am – 4:00 pm	Golf (optional)
8:00 am – 1:00 pm	Practice Management and CPT Coding and Billing for Pediatric Neurosurgery*—**Empress Room** Faculty: John Piper, MD
10:00am – 10:30am	Refreshments, Snacks and Exhibit Viewing—**Regent/Viceroy Rooms**
4:30 pm – 7:30 pm	Optional Meeting Extension*—**Empress Room** **"My Shunting is Better than Yours"** Moderators: D. A. Bruce, MD – H. E. James, MD Panelists: R. Abbott, MD – R. Humphreys, MD – J. Laurent, MD – T. G. Luerssen, MD – D. McLone, MD – H. L. Rekate, MD – R. A. Sanford, MD – M. L. Walker, MD – J. H. Wisoff, MD
5:30 pm – 6:00 pm	Break—**Empress Foyer**

* Please see Learning Objectives above.

Poster Session

1 **Experimental Cortical Dysplasia: Histological and Physiological Analysis**
Ethan A. Benardete, MD, PhD, Arnold R. Kriegstein, MD, PhD (New York, NY)

2 **Dural Closure in Pediatric Chiari Decompression: CSF complications with Varied Closure Methods**
Mark G. Luciano, MD, PhD, Toru Fukuhara, MD, Samer Elbabaa, MD

3 **Spinal Cord Syrinx Pulsations**
Bermans J. Iskandar, MD, Aclan Dogan, MD (Shreveport, LA), Peter Nguyen, MD (Madison, WI), Fred Lee, MD (Madison, WI)

4 **Subarachnoid Hemorrhage Without Angiographic Vascular Anomaly in Pediatric Sickle Cell Disease**
Chad Prusmack, MD, Jonathan Jagid, MD (Miami, FL), Dorene Beguiristian, RN (Miami, FL), John Ragheb, MD (Miami, FL)

5 **Intracranial Complications of Frontal Sinusitis in Children: Pott's Puffy Tumor Revisited**
Nicholas C. Bambakidis, MD, Alan R. Cohen (Cleveland, OH)

6 **Fibrous Tumors of the Calvarium: A Report of Two Cases and Review of the Literature**
Arthur J. DiPatri, Jr., MD, Eric Potts, MD (Baltimore, MD), Kymberly Gyure, MD (Baltimore, MD)

7 **Apoptotis, Cell Proliferation and Drug Resistance Markers in Low Grade Astrocytomas**
Philipp R Aldana, MD, Cheppail Ramachandran, PhD, Steve Melnick, MD, Andrew Jea, MD, P. Jhabvala, Anna Sotrel, MD, John Ragheb, MD Glenn Morrison, MD (Miami, FL)

8 **Prognostic Heterogeneity of Intracranial Juvenile Pilocytic Astrocytomas**
Benoit J. M. Pirotte, MD, Alphonse Lubansu, MD, Philippe David, MD, Catherine Christophe, MD, Eric Sariban, MD, Maurice Lipszyk, MD, Jacques Brotchi, MD, PhD

9 **Epigenetic Regulation of Gene Expression in a Human Medulloblastoma Cell Line Using CDNA Arrays**
Alex Mohit, MD, PhD, Gregory Foltz, MD, Gerald Grant, MD, Lorne Walker, Peter Nelson, MD, Richard Ellenbogen, MD (Seattle, WA)

10 **Identification of Methylation Controlled Gene Expression in High Grade Gliomas using CDNA Microarray Analysis**
Greg Foltz, MD, Alex Mohit, MD, PhD, Gerald Grant, MD, Lorne Walker, Michael Bobola, PhD, Peter S. Nelson, MD, Richard Ellenbogen, MD (Seattle, WA)

11 **Large Cell/Anaplastic Transformation of Medulloblastomas and Medullomyoblastomas: Clinicopathologic and Genetic Evidence for Tumor Progressi**
Jeffrey R. Leonard, MD, Dan X. Cai, MD, PhD (St. Louis, MO), Dennis J. Rivet, MD (St. Louis, MO), Bruce A. Kaufman, MD (St. Louis, MO), T. S. Park, MD (St. Louis, MO), Beth K. Levy (St. Louis, MO), Arie Perry, MD (St. Louis, MO)

12 **Synergistic Action of Genistein and Cisplatin on Growth Inhibition and Cytotoxicity of Human Medulloblastomas**
Sami Khoshyomn, MD, Paul L. Penar, MD (Burlington, VT), Sean M. Lew, MD (Burlington,VT), Steven L. Wald, MD (Cincinnati, OH), Gregory C. Manske, BS (Burlington, VT)

13 **Predictive Value of MR Spectroscopy in Pediatric Brain Tumors**
Amir Vokshoor, MD, Gregory W. Baltursbot, MD (Columbus, OH), Jerome Rusin, MD (Columbus, OH), Edward J. Kosnik, MD (Columbus, OH)

14 **Intracranial Ependymomas in Children**
Benoit J. M. Pirotte, MD, Frank Van Calenbergh, MD (Leuven, Belgium), Christian Plets, MD (Leuven, Belgium), Jacques Brotchi, MD, PhD (Brussels, Belgium)

15 **Supratentorial Oligodendrogliomas in Children and Adolescents**
Daniel C. Bowers, MD, Linda Margraff (Dallas, TX), Deborah L. Doxey (Dallas, TX), Arlynn F. Mulne (Dallas, TX), Bradley Weprin (Dallas, TX), Derek A. Bruce (Dallas, TX)

16 **Pediatric Dorsally Exophytic Brainstem Gliomas: Value of Aggressive Surgical Resection**
Renetta J. Osterdock, MD, Dwight E. Herron, MD (Memphis, TN), Richard L. Heideman, MD (Memphis, TN), Robert A. Sanford, MD (Memphis, TN), Larry E. Kun, MD (Memphis, TN)

17 **Interest of Combining Positron Emission Tomography and Magnetic Resonance Imaging in the Planning of Stereotactic Brain Biopsies in Children : Preliminary Experience in 9 Cases.**
Benoit J. M. Pirotte, MD, Sacha Salzberg, MD, Patrick Van Bogaert, MD, PhD, Serge Goldman, MD, PhD, Delphine Lejeune, MD, Marc Levivier, MD, PhD (Brussels, Belgium), Jacques Brotchi, MD, PhD (Brussels, Belgium)

18 **Enhanced Preoperative Planning Using Composite Digital Holograms Coregistered with Frameless Stereotaxy for Pediatric Low Grade Glioma Surgery**
John J. Collins, MD, Raymond A. Schulz, MSc (San Francisco, CA), Michael N. Dalton, BSci (Provo, UT), Stephen J. Hart, BSci (Provo, UT)

19 **Failure of Autogenous Cranioplasty Following Decompressive Craniectomy in Children**
Gerald A. Grant, MD, Matthew Jolley, BS, Gregory D. Foltz, MD (Seattle, WA), Joseph R. Gruss MD, Richard G. Ellenbogen, MD (Seattle, WA), Theodore S. Roberts, MD (Seattle, WA), H. Richard Winn, MD (Seattle, WA), John D. Loeser, MD (Seattle, WA)

20 **Craniosynostosis in the Perinatal Rat Using Methyl-2-Cyanoacrylate: a Neuroanatomic Study**
Khalid A. Sethi, MD, Walter Low, PhD (Minneapolis, MN), Cornelius H. Lam, MD (Minneapolis, MN)

21 **Cranioplasty in the Young Child: Successful Use of Rib**
Derek A. Taggard, MD, Arnold H. Menezes, MD (Iowa City, IA)

22 **The Surgical Correction of Metopic Synostosis**
Mark D. Krieger, MD, J. Gordon McComb, MD (Los Angeles, CA), Michael L. Levy, MD (Los Angeles, CA)

23 **Pluronic Surfactant Polymer as a New Bone Hemostatic Agent in Children That Does Not Impair Osteogenesis**
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Scientific Oral Abstracts

1 Intrauterine Myelomeningocele Repair: An Update

AUTHORS: Noel B. Tulipan, MD, Joseph P. Bruner, MD (Nashville,TN)

ABSTRACT: A total of 102 intrauterine myelomeningocele repairs have been performed at Vanderbilt University Medical Center since April of 1997. Forty-four of those patients are now one year old or greater. Of those, 30 (68%) have required a VP shunt. While this percentage is an improvemnt over published shunt rates for patients with spina bifida (80-95%), it remains unclear whether the risks of surgery justify the relatively modest benefit. We have therefore attempted to identify subgroups of patients more likely than others to benefit from intrauterine repair. Statistical analysis of a variety of factors suggests that three in particular are useful in predicting the need for shunting: gestational age at repair, level of lesion, and degree of hydrocephalus at the time of repair. In a group of ten patients who were less than 25 weeks, had lesions at L4 or lower, and ventricles less than 14mm at the time of repair the shunt rate at one year is 10%. The implications of this finding will be discussed. In particular, it would appear that patients without hydrocephalus, or with mild hydrocephalus, at the time of repair are the most likely to escape shunting. Given the known natural history of the hydrocephalus associated with spina bifida to progress throughout gestation, it seems likely that intervention as early in gestation as possible will maximize the opportunity to avoid shunting.

2 Understanding Oligodendrocyte Loss Following Perinatal Ischemia

AUTHORS: Shenandoah Robinson, MD, Kasia Petelenz, BA (Cleveland, OH), Robert H. Miller, PhD (Cleveland, OH)

ABSTRACT: Cerebral palsy (CP) is a devastating problem for patients, their families, and society. CP is strongly correlated with neonatal white matter lesions (WML). In humans oligodendrocytes arise in the perinatal period, the time when the insults that cause CP occur. Oligodendrocyte lineage development is dependent upon precise spatio-temporal regulation of complex cellular interactions mediated by cytokines. We hypothesized that perinatal insults induce abnormal cytokine expression that disrupts growth factor regulation of oligodendrocyte development. Methods: A rat prenatal ischemia model was used to examine the disruption of oligodendroglial lineage development and cytokine expression using immunohistochemistry, proliferation and apoptosis assays. Animal model data were correlated with human infant postmortem data. Results: In the rat model, prenatal ischemia did not affect the number of oligodendrocyte precursor cells, but induced a significant reduction in the number of mature oligodendrocytes. The decrease was due to diminished survival, rather than limited oligodendrocyte precursor migration, proliferation, or differentiation. The prenatal insult hindered platelet-derived growth factor expression, and was related to increased tumor necrosis factor-alpha expression. The human data appeared to correlate well with the animal model results. Conclusions: The prenatal rat insult induced aberrant cytokine expression that disrupted growth factor secretion by astrocytes and neurons necessary for oligodendrocyte survival. The current study was designed to define the cellular and molecular mechanisms that mediate oligodendrocyte loss and WHL following early CNS injury. These results provide insights into potential interventions that can be administered in the neonatal period to minimize the development of WML, and thus cerebral palsy.

3 Anterograde Trophic Support to the Developing Striatum: Role of Glutamatergic Afferents

AUTHORS: Sandeep Mittal, MD, MA, Alonso-Vanegas, MD (Montreal, PQ), R. Aloyz, PhD (Montreal, PQ), F. D. Miller, PhD (Montreal, PQ), A. F. Sadikot, MD, PhD (Montreal, PQ)

ABSTRACT: The final number of neurons in the central nervous system (CNS) is determined by complex genetic and microenvironmental factors, including proliferation, developmental cell death, and neurotrophic support. The mammalian striatum receives massive glutamatergic afferents from the thalamus and cortex. We determined the role of thalamic afferents in providing trophic support for projection neurons in the developing rat striatum.

We developed a model based on early lesions of the thalamostriatal system. Thalamic lesions were centered on the parafascicular (Pf) nucleus at postnatal day 2 (P2). Microscopic analysis using unbiased stereology in adult animals revealed massive loss of the principal GABAergic neurons of the striatum compared to unlesioned controls. In order to determine possible molecules that may contribute to trophic support by the thalamus, we quantified changes in brain-derived neurotrophic factor (BDNF) protein content and trkB receptor phosphorylation state. Early thalamic lesions were associated with significant loss of BDNF protein and reduced trkB receptor phosphorylation.

These findings are in keeping with the hypothesis that glutamatergic thalamostriatal afferents rescue striatum neurons from developmental cell death. BDNF is transported anterogradely in the thalamostriatal system, and may be released by activity-dependent mechanisms to regulate neuronal survival. The thalamostriatal system may be used as a model to study mechanisms of anterograde trophic support in the developing mammalian CNS.

4 Magnetic Resonance Study of Ventricular Dilatation and CSF Drainage in an Acute Reversible Hydrocephalic Guinea Pig Model

AUTHORS: Shinya Yamada, MD, Masayoshi Shibata (Los Angeles), Miriam Scadeng (Los Angeles), Stefan Bluml (Los Angeles), Catherine Nguy (Los Angeles), Brian D. Ross (Los Angeles), J. Gordon McComb, MD (Los Angeles)

ABSTRACT:

Introduction: Most laboratory models studying hydrocephalus use animals that have congenital hydrocephalus or develop hydrocephalus following the inflammatory response that results from kaolin injected into the cisterna magna. We sought to develop an acute reversible hydrocephalic model in order to study the changes in ventricular size and CSF drainage pathways in response to intraventricular pressure.

Materials & Methods: Under anesthesia a polyethylene tube was inserted into the aqueduct of Sylvius of adult guinea pigs and the aqueduct completely blocked by gently packing cotton around the tube. Artificial CSF containing gadolinium was then infused at various rates into the third ventricle and the intraventricular pressure monitored. Serial magnetic resonance studies were done to monitor ventricular size and note CSF drainage sites.

Results: Ventricular enlargement occurred within minutes and rapidly progressed in response to third ventricular infusion. Also within minutes, gadolinium was noted to be present in high concentration in the nasal mucosa and periorbital region while there was little to none over the convexities of the hemispheres and in the region of the superior sagittal sinus. The ventricles rapidly deflated after withdrawing fluid via the tube.

Conclusion: The present animal model may more closely mimic the clinical situation than other laboratory models. Rapid drainage of CSF into non-arachnoidal granulation pathways was noted.

Scientific Oral Abstracts

5 Magnetic Resonance (MR) Spectroscopic Changes in Pediatric Patients with Acute Hydrocephalus, Hydrocephalus and Cortical Atrophy

AUTHORS: Miriam Scadeng, MD, Rex A. Moats, Marvin D. Nelson, Jr., Michael L. Levy, MD (Los Angeles, CA), J. Gordon McComb, MD (Los Angeles, CA)

ABSTRACT:

Introduction: Animal models of acute hydrocephalus demonstrate a significant reduction in the N-acetyl aspartate [a neuronal marker] ? creatine [an indicator of energy metabolism] (NAA/Cr) ratio, a finding seen in children with cortical atrophy but not usually with hydrocephalus. To investigate this apparent contradiction a group of pediatric patients were studied using MR spectroscopy.

Materials: Twenty-four infants and children (0-16 years with a mean of 4.7 years) underwent MR spectroscopy in addition to standard MR imaging. Of this group, 5 patients had rapidly progressive acute hydrocephalus secondary to a tumor obstructing CSF drainage pathways, 9 with hydrocephalus but without the acute symptoms, and 10 with cortical atrophic changes.

Results: The NAA/Cr ratios were significant reduced in patients with acute hydrocephalus and cortical atrophy but not in the hydrocephalic group without acute symptoms.

Conclusion: The changes in NAA/Cr ratios appear to reflect ischemia in acute hydrocephalus and neuronal loss in cortical atrophy. Further studies need to be done to see if theNAA/Cr ratio returns to normal if ischemia is eliminated.

6 Comparison of Subgaleal Shunts and Ventricular Reservoirs in the Initial Management of Post-Hemorrhagic Hydrocephalus in Premature Infants

AUTHORS: Christopher A. Gegg, MD, Dale M. Swift, MD (Dallas, TX)

ABSTRACT:

Introduction: In order to decrease the rates of shunt infection in premature infants with posthemorrahic hydrocephalus (PHH) numerous temporizing measures are currently in use, including subgaleal shunts and ventricular reservoirs. To determine the advantages and disadvantages of each device a ten year retrospective review was performed comparing outcomes in all premature infants with PHH in whom these devices were placed.

Methods: In the years 1990 to 1999, 70 premature infants with PHH were identified who underwent either subgaleal shunt or ventricular reservoir placement. There were 44 subgaleal shunts and 26 ventricular reservoirs. Chart review recorded patient sex, birth weight, gestational age, IVH grade, initial frontal occipital horn ratio (FOHR), age and weight at the time of the first device and at the first VPS. Outcome data included infection and failure rates of the first device and the subsequent VPS. FOHR's were also recorded before permanent shunt placement and at one year follow-up. Operating surgeons and their baseline shunt infection rates were also recorded.

Results: There were no significant differences in the birth weights and gestational ages of the two groups, nor in the weights or ages at the time of surgeries. Infections occurred in 9 of 44 subgaleal shunts (20%) and 0 of the 26 reservoirs. A higher infection rate was also observed in the subgaleal patients following removal of the device and VPS placement (13.6% vs. 3.8%). Baseline infection rates of the operating surgeons did not appear to account for the observed differences. No significant difference in the follow-up FOHR of the two groups was detected.

Discussion/Conclusion: In this study subgaleal shunts were associated with a higher infection rate than ventricular reservoirs. The increased risk extended to the initial VPS. Despite intermittent drainage, ventricular reservoir resulted in comparable reductions in ventricular size to subgaleal shunts.

7 Ten Children with Coccidioidomycosis Meningitis: Clinical Presentation, Treatment, and Long Term Prognosis

AUTHORS: Charles J. Wrobel, MD, Kevin Taubman, MD (Bakersfield, CA)

ABSTRACT: Coccidioidomycosis acquired by inhalation of infectious spores may disseminate to extra-pulmonary locations. Dissemination to the cerebrospinal fluid resulting in meningitis is a serious condition in adults and has been thoroughly reported. This is the first series of coccidioidomycosis meningitis in children. Seven male and three female patients have been evaluated and managed since 1992 with follow-up of three to eight years. Black, Hispanic, and Asian children were disproportionately represented compared to local demographics. Meningitis was the first manifestation of disseminated coccidioidomycosis in almost every case. Skin tests were uniformly negative. Lumbar cerebrospinal fluid IgG titers against C. immitis were the most useful diagnostic test; the IgM antibody was positive in only 50%. C. immitis was cultured directly from the CSF in four patients, all of whom had impressive CSF leukocytosis (300-1200 WBC/cu mm) and required a ventriculoperitoneal shunt on presentation. In serious cases intravenous amphotericin was initiated followed by oral fluconazole. Two other patients required shunts one and four years after diagnosis. These patients were poorly compliant with fluconazole; treatment failure was heralded by increases in CSF IgG titers and worsening CSF leukocytosis. Four children achieved remission with fluconazole and have not developed hydrocephalus.

Cranial neuropathies, vasculitis, and aggressive arachnoiditis - major causes of morbidity in adults - did not occur. In the shunted patients, morbidity was related to shunt failure. Serious pulmonary disease or widespread dissemination was uncommon. The overall prognosis for coccidioidomycosis meningitis in children is good if there is compliance with oral fluconazole and hydrocephalus is controlled.

8 Does Cine MRI (CMRI) Help Predict Favorable Outcome or Symptoms in Children with Chiari I Malformations (CIM)?

AUTHORS: Ann M. Ritter, MD, William Frawley, PhD (Dallas, TX), Katie Dominquez, PA (Dallas, TX), Nancy Rollins, MD (Dallas, TX), Dale Swift, MD (Dallas, TX), Derek Bruce, MD (Dallas, TX)

ABSTRACT: This study compares CMRI in normal and CIM children (surgery versus none) to determine radiographic characteristics that may help diagnose or determine the need for surgery. Methods: 112 patients underwent CMRI from 5/96-12/99; 36 patients had tonsillar herniation and underwent surgery (C1MS), 53 had CM and no surgery (C1M), and 23 had no radiographic evidence of CM (N). Pre/post-operative ventral(V) and dorsal(D) CSF flow and abnormal motion of the cerebellar tonsils/brainstem(BS/T) were documented. Symptoms included headaches, cranial nerve symptoms, and neurologic deficits. Results: Headaches (p equal to 0.003), cranial nerve deficits (p less than 0.0001) and neurological deficits (p less than 0.0001) were more likely in C1MS than C1M. Pre-operative BS/T (p less than 0.0001), V (p less than 0.006) and D (p less than 0.0001) were different between C1M compared to N. V (p less than 0.0001) and D(p equal to 0.001) were different between C1MS and C1M. 92% C1MS (31/34) and 85% C1M (40/47) had BS/T on initial MRIs. Post-operatively, 74% (14/19) had improvement in BS/T (95% CI=(0.49,0.91)), 58% (14/24) in D(95% CI=(037,0.78)), and 21%(5/24) in V(95% CI=(0.07,0.43)). Cross table analysis failed to show significant correlation between CMRI and preoperative symptomatology. Conclusion: There is abnormal BS/T and a decrease in V/D in patients with CM. Radiographic improvement occurred after surgery. The clinical pattern rather than the CMRI weighed most heavily in the decision for surgery

9 Outcome of Scoliosis After Chiari Decompression

AUTHORS: Michael H. Handler, MD, FACS, FAAP, James M. Eule, MD, Patti Batchelder, RN, MSN, Mark A. Erickson, MD, Michael O'Brien, MD

ABSTRACT: The Chiari I malformation is a cause of syringomyelia, and so is among the neurogenic causes of scoliosis. We reviewed records of patients with the Chiari I malformation and scoliosis, to determine whether an operation to correct the malformation affected the course of their spinal deformity. 19 patients were identified, 2 of whom already had undergone a fusion for scoliosis when they underwent decompression because of other symptoms, and 2 more had decompression at the time of their fusion. Of the remaining 15 patients, 7 have progressed to require fusion. These patients had more severe curves at the time of diagnosis with the Chiari malformation, and were of an older age at decompression (greater than 8 years). 8 patients have not undergone fusion : 4 have had improvement in their curves, 1 has stabilized, 2 have had mild progression not requiring fusion, and one has refused the spinal stabilization. Aggressive early imaging in ideopathic scoliosis to diagnose and treat the Chiari I malformation may reduce the need for spinal fusion in some patients.

10 Craniocervical Instability in Patients with Mucopolysaccharidosis, Review of 30 Cases

AUTHORS: Essam A. Al Shail, MB, BS, Abdulsattar Ghomraoui, MD (Riyadh, Saudi Arabia), Pinar Ozand, MD (Riyadh, Saudi Arabia)

ABSTRACT:

Background: Mucopolysaccharidoses are primary metabolic abnormalities of the carbohydrate metabolism. They are inheritable storage diseases manifest by mental retardation, macrocephaly, corneal clouding, small stature and dwarfism as well as skeletal dysplasia. Generalised ligamentous laxity is thought to contribute to atlantoaxial subluxation. The aim of this presentation is to review our experience in the treatment of mucopolysaccharidosis in children with craniocervical instability.

Methodology: A retrospective review of all cases treated in our facility since 1980.
Result: We have reviewed 45 patients with mucopolysaccharidosis treated in our facility. The 25 females and 20 males were aged from 1 to 180 months at the metabolic presentation. The diagnosis (Austin disease 22, Morquio syndrome 20, others 3) was confirmed by a battery of investigations including skin biopsy. Twenty-five patients had a neurological complaint at the time of presentation; 16 of 25 had craniocervical instability. The timing of surgery, the procedure, the outcome and the complications are expounded.

Conclusions: The surgical treatment for this group of patients should be offered as early as possible and preferably at the time of establishing the craniocervical instability. The reason for this is that most of these patients will eventually develop an airway problem due largely to mucopolysaccharide deposition, and the progression of the myelopathy. An alternative method of treatment is bone marrow transplantation, which is useful in advanced cases.

11 Predicting the Risk of Stroke in MoyaMoya Disease Using XenonCT

AUTHORS: David J. McAuley, MB, FRCS, Ken Poskitt, MDCM (Vancouver BC), Paul Steinbok, MB, FRCSC (Vancouver, BC)

ABSTRACT:

Purpose: To determine if Xenon CT (XeCT) regional cerebral blood flow (rCBF) estimates in children with MoyaMoya disease can predict which tissue is at risk of stroke before and after treatment.

Method: Seven patients with MoyaMoya disease underwent 16 serial XeCT studies. Estimates of rCBF were performed at three CT levels using a 5 minute inhalation of 28% Xenon. Acetazolamide challenge was performed in 8 studies. 17 angiograms, 47 CT and 12 MR studies were available for comparison of abnormal vessel distribution and areas of infarction. Post treatment follow-up exceeded 2 years.

Results: Of 6 XeCTs performed at diagnosis, 4 showed regions of oligaemia, and demonstrated of augmented vertebrobasilar flow and regions of carotid steal after acetazolamide. In the delay between diagnosis and treatment, 3 patients suffered strokes in ischaemic regions identified by XeCT. Of the 10 post treatment studies of 4 patients, two showed improved tissue perfusion with angiography confirming successful EDAMs; in 2 others, 6 month XeCTs showed improved perfusion without angiographic change, and angiography at one year showed failed EDAMs and new native collaterals. None of the patients with improved rCBF developed new strokes. 11/14 XeCT studies occurred within 30 days of angiography. Comparison of these studies shows that regions of oligemia were confined to areas associated with vessel stenosis and little neovascularity or collaterals.

Conclusion: XeCT, particularly with acetazolamide challenge, objectively quantifies rCBF and permits the evaluation of stroke risk in children with Moya Moya disease and may predict surgical outcome earlier than angiography.

12 Complex Reconstruction/ Bypass Versus Trapping in Giant Intracranial Aneurysms In Children And Adolescents

AUTHORS: Michael L. Levy, MD, Larry Khoo, MD (Los Angeles, CA), J. Gordon McComb, MD (Los Angeles, CA)

ABSTRACT: Giant intracranial aneurysms in children require aggressive treatment. We assessed the utility of bypass or diversion procedures in these cases. Giant aneurysms (2-5 % of all aneurysms) represent 24% of our series (18/76). Of these 18 cases (ages 1.5m to 18 yrs, mean = 5 yrs), 5 attempts at complex reconstruction failed resulting in thrombosis of the parent vessel. 10/18 (55%) of patients with giant aneurysms presented with sub-arachnoid hemorrhage, 13/18 (72%) with mass effect and 6/18 (36%) with both. The locations of all aneurysms and failure rates are as follows, posterior circulation 7/18 (1 failure, 14%), carotid bifurcation 5/18 (1 failure, 20%), distal middle cerebral artery 3/18, proximal carotid artery 3/18 (3 failures, 100%) and pericallosal region 1/18. The operative modalities included clip ligation (5), excision (1), clipping with wrapping (2), clipping under cardiac standstill (1), trapping (1), trapping with bypass (4), and intra-vascular coil embolization (4).

Complications included intraoperative rupture (3), perforator injury (1), cerebral edema (1), transient hemiparesis (3, 2 secondary to failure), transient cranial nerve palsy (2), permanent cranial nerve palsy (1 secondary to failure) and vasospasm (1). Outcome was excellent in 9 patients, good in 4, poor in 4, and 1 patient died.

Of those occluded, injury included cranial nerve abnormalities in a cavernous aneurysm and a field cut and transient hemiparesis in a P3 aneurysm. Trapping is appropriate in giant aneurysms and should potentially be the initial consideration for giant aneurysms involving the proximal carotid artery.

13 Endovascular Management of Pediatric Lesions

AUTHORS: Indro Chakrabarti, MD, Arun P. Amar, MD (Los Angeles, CA), Michael L. Levy, MD (Los Angeles, CA), Don Larsen, MD (Los Angeles, CA), J. Gordon McComb, MD (Los Angeles, CA), George P. Teitelbaum, MD (Los Angeles, CA)

ABSTRACT:

Purpose: To delineate the impact of endovascular capabilities on the management of pediatric vascular and neoplastic disorders.

Methods: 82 children underwent 149 procedures over a 5-year period. There were 58 males and 24 females (mean 11.7 years, sd 4.3). Follow-up ranged from 6- 60 months. Endovascular treatments were performed on 61 vascular malformations (46 cerebral AVMs, 3 facial AVMs, 4 spinal AVMs, 6 dural AVFs, 2 CCF), 15 vascular neoplasms (e.g. juvenile angiofibroma, hemangioma), 5 aneurysms, and 1 dural sinus thrombosis. Several other patients underwent purely diagnostic imaging (e.g. intra-operative angiography) but are not included in this study.

Results: Pediatric AVM's often required multiple pedicle injections (mean 6.2) and multiple treatment sessions (mean 1.9). All 8 patients with AV fistulae (dural AVF and CCF) had complete resolution after a total of 18 treatments. Three other patients with AVFs (spinal dural AVF, scalp fistulae) also had complete resolution. Complications occurred in 10 patients, including non-target embolization (2), AVM rupture (1), dissection requiring angioplasty and stenting (1), epistaxis following TPA administration (1), recurrence of a coiled aneurysm (1), post-embolization seizure (1), and facial cellulitis (3). Neurological deficits resolved in 9 of the 10 patients. There was 1 mortality, occurring in a child with a large vein of Galen malformation following coiling.

Conclusions: The morbidity of endovascular therapy in the treatment of pediatric vascular and neoplastic lesions is low, with only one death and one permanent complication in our series. Embolization represents a valuable adjunct in the multimodality management of these disorders.

14 Surgical Treatment of Spinal Arteriovenous Malformations in the Pediatric Population

AUTHORS: Howard A. Riina, MD, Nicholas Theodore, MD (Phoenix, AZ), Jonathan Hott, MD (Phoenix, AZ), Harold L. Rekate, MD (Phoenix, AZ), Robert F. Spetzler, MD (Phoenix, AZ)

ABSTRACT:

Introduction: Spinal cord arteriovenous malformations (AVMs) are rare lesions involving abnormal connections between the arterial and venous systems. Traditionally, these lesions have been classified into types I-IV, based on their location and angioarchitecture. We present 11 pediatric patients with spinal cord AVMs who underwent surgical resection.

Methods: Eleven patients (7 males, 4 females) underwent surgical resection of their spinal AVMs. Their mean age at presentation was 12.7 years (range, 1 to 18 years). Preoperative spinal angiography was performed in all cases, and preoperative embolization was performed in four cases. All patients underwent a posterior, posterolateral, or posterolateral anterior approach with laminectomy or laminoplasty.

Results: Of these 11 patients, 27.2% improved after surgical resection, 54.6% remained the same, and 18.2% had mild weakness after surgery. Complete resection was achieved in 54.6% of cases.

Conclusions: Spinal cord AVMs are rare lesions and can be difficult to treat surgically. Their resectability depends on the type of lesion and its angioarchitecture. Complete resection can be achieved using the principles of AVM microsurgery: intraoperative monitoring, selective intraoperative angiography, meticulous preservation of the anterior spinal artery, sharp dissection, and preoperative embolization in selective cases. Our experience suggests that most spinal cord AVMs can be safely resected by adhering to these tenets.

15 Stereotactic Radiosurgery for Pediatric Intracranial Arteriovenous Malformations

AUTHORS: Matthew D. Smyth, MD, Elaine Park, RN (San Francisco, CA), Penny K. Sneed, MD (San Francisco, CA), Michael Lawton, MD (San Francisco, CA), Michael W. McDermott, MD (San Francisco, CA)

ABSTRACT:

Introduction: Radiosurgery (RS) for arteriovenous malformations (AVMs) is an accepted therapeutic option, but there is little data about the results of treatment in children. Methods: From 1991 to 1997, a total of 40 pediatric patients (26 boys, 14 girls) with AVMs were treated. Follow-up information was available for 31 children (77.5%), with a mean duration of 55.5 months (range 6-95 mo). Spetzler/ Martin classification of AVMs revealed the following distribution: 16.1% Grade II; 67.7% Grade III; 9.6% Grade IV and; 6.5% Grade V . The mean/median prescription dose per treatment session was 1953/1400 cGY (range 1199-1900). Results: Of the 26 children who underwent angiography after RS, AVM obliteration was noted in 7 (22.6%), partial responses in 18 (58.1%), and no response

in 1 (9.3%). Five of the partial responders had a tiny residual such that further treatment was not recommended. No hemorrhages have occurred in this group. During follow-up there were 7 hemorrhages in 5 patients, yielding a cumulative post-treatment hemorrhage rate of less than 1% per year. Three patients developed new neurologic deficits (hemiparesis and/or visual field loss). One patient underwent craniotomy for removal of residual AVM after a hemorrhage. There were no deaths. Conclusions: The obliteration rate reported here is low compared to previously published rates for adult AVMs after radiosurgery. The permanent complication rate is low and should encourage those treating children to use the same doses as for adults.

16 Growth Rate of Vestibular Schwannomas in Neufibromatosis Tyoe-2 Early in Life

AUTHORS: Sebastian Thomas, Cordula Matthies, MD (Hannover, Germany), Katja Kniese, MD (Hannover, Germany), Marcos Tatagiba, MD (Hannover, Germany), Madjid Samii, MD (Hannover, Germany)

ABSTRACT:

Objective: Neurofibromatosis Type-2 (NF-2) is a rare genetic disease occurrying with an anual incidence of approximately 1:35.000. The prognosis regarding life quality is particular dependent on proper indication for surgery. The aim of the present paper is to determine the natural growth rate of vestibular schwannomas in NF-2 in the early age group (below 20 years) in comparison with later onset of the illness in life.

Methods: Within the past 20 years a total number of 221 patients with NF-2 were treated in our Department. In 62 patients repeated MRI-scans were obtained and growth rate of 93 unoperated vestibular schwannoms was determined. Therefore, the maximum diameter in all 3 dimensions (AP: anterior-posterior; ML: medial-lateral; CC: cranio-caudal) was measured and tumor volume was calculated using following formula: Volume= */6*AP*ML*CC.

Results: The observation period ranged from 5-110 months. The overall growth rate was 2.28±3.72 ccm / year. The correlation between age of illness-onset and tumor-growth/year is as follows: 5-19 years: 2.47±3.5 ccm/year (N=59); 20-29 years: 1.31±1.71 ccm/year (N=24); 30-39 years: 4.36±7.1 ccm/year (N=8); 40+ years: 0.096±0.077 ccm/year (N=2).

Conclusions: In patients with early onset of Neufibromatosis Type-2 vestibular schwannomas tend to grow more rapidly compared to a later onset in life and should be taken into consideration regarding timing of surgery.

17 Salvage Therapy After Relapse in Medulloblastoma

AUTHORS: Stephen L. Huhn, MD, Paul G. Fisher, MD (Stanford, CA), Quynth Le, MD (Stanford,CA), William Wara, MD (San Francisco, CA), Kathleen Lamborn (San Francisco, CA), Rhonda Zachary, MD (San Francisco, CA), Tress L. Goodwin (Stanford, CA), Michael D. Prados, MD (San Francisco, CA)

ABSTRACT:

Background: Survival after recurrent medulloblastoma is perceived as limited. To better understand the outcome of recurrent medulloblastoma, the failure patterns and survival for children with relapsed medulloblastoma for two institutions were analyzed.

Methods: The brain tumor registries at two separate institutions were searched to compile a cohort of children with recurrent medulloblastoma. Relapse was defined as progression of disease at the primary site or the development of exo-primary tumor. Recurrence was confirmed by neuro-imaging, CSF cytology, and/or biopsy.

Results: Ninety-seven children (male=67, median age 8.9 yr, SE=0.6 yr) were reviewed from 1965 to 1998. Median time to relapse was 1.0 yr (SE=0.2 yr). Age at relapse was positively associated

with time to relapse (p=0.01). There were 33 primary site relapses, 33 with primary and exo-primary progression, and 29 with exo-primary failure only. Salvage therapy generally consisted of a multimodal approach. One-year, two-year, and five-year overall survivals from relapse were 47.9% (SE=5.1%), 32.2% (SE=4.9%), and 12.3% (SE=3.6%), respectively. There was a trend toward improved survival in those children who had received radiotherapy as part of the initial adjuvant treatment (p=.19).

Conclusion: Younger age was associated with earlier relapse. Salvage therapy for medulloblastoma did yield some long-term survivors. Clinical variables such as age, extent of disease, time to relapse, or therapy at recurrence do not appear to influence outcome after recurrence. Radiotherpy at initial treatment for medulloblastoma may exert a protective effect in improving survival after progression.

18 Giant Cell Glioblastoma of Pediatric Population: A Study of Eighteen Cases

AUTHORS: Indro Chakrabarti, MD, Sooho Choi, MD (Los Angeles,CA), Michael L. Levy, MD (Los Angeles, CA), Floyd H. Gilles, MD (Los Angeles, CA), J. Gordon McComb, MD (Los Angeles, CA)

ABSTRACT: A rare variant of glioblastoma, giant-celled glioblastoma is characterized by bizarre multi-nucleated giant cells which dominate the tumor histology. Few reports have studied this subtype of glioblastoma, however, case reports have described accounts of long-term survival, particularly in pediatric cases. In this series we review data collected from the Childhood Brain Tumor Consortium concerning eighteen pediatric cases. Eleven males and seven girls ranging from ages two through nineteen had variable clinical presentations including alterations of consciousness, cranial nerve palsies, seizures, and long-tract findings. Fourteen tumors were supratentorial and four were infratentorial. Tumors were treated with biopsy only (1/18), biopsy with chemotherapy and/or radiation (2/18), partial resection only (3/18), partial resection with adjuvant therapies (10/18), or total resection followed with adjuvant therapies (2/18). Surgeries took place between decades of the 1940's and 1980's. At surgery descriptors including cystic components, firm, friable, yellow-tan coloring, vascular, soft, and infiltrative were oft used. Characteristic histologies were seen in all tissues. Survival times ranged from a few days to 10.5 years. Mean survival was 1.8 years, however, there was a 6 and a 10.5 year survivor in the series. Survival distribution functions for the supratentorial tumors indicate 50% survival after one year and 17% survival after two years. The above data indicates while there are some isolated cases of longer survival, mean survival for giant-celled glioblastoma is only slighlty longer than glioblastoma.

19 Pediatric Ependymoma (40 in 36 months)

AUTHORS: Renetta J. Osterdock, MD, Robert A. Sanford, MD (Memphis, TN), Thomas E. Merchant, DO, PhD (Memphis, TN)

ABSTRACT: At this point in time the proven favorable prognostic factors for ependymoma are extent of disease (localized), extent of resection (gross total), and adequate radiation therapy (greater than 54Gy). Soft favorable prognostic factors are differentiated histology, older age, and primary site (supratentorial). Historially, complete resection and postoperative radiation therapy confers an 80% 5-year progression free survival; compared to 35% in children with incomplete resection followed by irradiation. Published series report a 40-50% rate of gross total resection. We report our surgical results in 40 children treated at St. Jude Children's Research Hospital from April 1997 until April 2000 (36 months) with 85% gross total resection. Eight children presented untreated and in 8 a complete resection was obtained. Sixteen were referred after complete resection for conformal (focused) radiation to be delivered in a protocol setting. Sixteen were referred with residual disease after an unsuccessful attempt at gross total resection (all posterior fossa). Twelve were reoperated and a gross total resection was achieved in 10; 2 had residual tumor measuring less than 1 cm. These 34 children (85%) demonstrated the feasibility of obtaining gross total resection in 80-90% of

children with ependymoma. Following this pilot study, the methodology used to increase the rate of gross total resection for ependymoma will become a COG (Children's Oncology Group) protocol in the fall of 2000. The modalities of presurgical chemotherapy to facilitate surgical resection and the use of quadriscopic vision (2 neurosurgeons) used to achieve these results will be detailed.

20 Brainstem Gliomas: A 10-year Institutional Review

AUTHORS: Jean-Pierre Farmer, MD, CM, FRCS(c), José Luis Montes (Montreal,Quebec, Canada), Carol R. Freeman (Montreal,Quebec, Canada), Mason C. Bond (Montreal,Quebec, Canada), Kathleen Meagher-Villemure (Lausanne, Switzerland), Augustin M. O'Gorman (Montreal,Quebec, Canada)

ABSTRACT: Case records of 37 patients with a diagnosis of brainstem glioma treated at The Montreal Children's Hospital from June 1989 to June 1999 were reviewed. 15 patients had the so-called "black pons" diagnosis and 22 patients other forms of brainstem gliomas. The two groups were compared with respect to age, clinical evolution, radiological appearance, type of surgery practiced, histological diagnosis, adjuvant treatments, and survival.

A non-pontine brainstem location, a cystic or exophytic component, bright enhancement with gadolinium injection, a histological diagnosis of pilocytic astrocytoma or ganglioglioma were favorable prognostic factors. At the time of follow-up, disease-free survival following active treatment was eight times longer in the group of patients not exhibiting a "black pons". The relative impact of radical surgery and/or radiotherapy is analized. Surgery coupled to adjuncts such as navigation, ultrasound and monitoring plays an important role for non-"black pons" brainstem lesions - focal/conformal radiotherapy has an adjuvant role. Patients treated with radiotherapy first followed by surgery have equal survival, but higher morbidity.

21 Management of Thalamic Tumors in Children

AUTHORS: George I. Jallo, MD, Diana Freed, MS (New York, NY), Fred Epstein, MD (New York, NY)

ABSTRACT:

Objective: The surgical management of thalamic tumors has been controversial. We review our management of 48 children with thalamic tumors.

Methods: We selected 48 children who fulfilled the criteria for thalamic tumors from 1986 to 1999. Children with tumors in the pineal region, third ventricle, brainstem and hypothalamus were excluded. We had 23 children, mean age 10.3 years, with a longterm follow-up of 42.4 months (range, 1.1 to 13.2 years). The presenting symptoms were raised intracranial pressure 13 (56%) children,or motor deficit 13 (56%). The mean prodrome was 57 days. The neoplasm was in the left thalamus in 15 cases, right in 6 and bithalamic in 2 cases. A biopsy, endoscopic or stereotactic, was performed for 6 children, and a resection performed in the remaining 17 children. The surgical approach was transcallosal for 8 children and a transcortical approach for 9 children. Transient deficits occurred in 9 children (mutism, hemiparesis, cranial nerve) and permanent deficit in 2 children. The histology included low grade astrocytoma 6, high grade astrocytoma 12, mixed glioma 3, and PNET 3 cases. The overall survival in this group of children was 52%. However, all low grade tumors are still alive, whereas only 36% of high grade tumors are alive. The mean survival was 23 months.

Conclusions: Thalamic tumors are rare neoplasms in children. The overall prognosis of children with tumors in this location depends upon the histological diagnosis.

22 Diabetes Insipidus and Serum Sodium in the Perioperative Period of Craniopharyngioma Resection

AUTHORS: Cynthia M. Cupido, MD, L. Dalle Mullel, MD, M. Halperin, MD, J. Blount, MD, D. Bohn, MD (Toronto, Ontario, Canada)

ABSTRACT:

Intro: Diabetes insipidus (DI) is a common complication of craniopharyngiomas (CP) resection. It is not clear however, how the presence of DI affects sodium and water balance during the immediate perioperative period. A retrospective study was conducted to understand perioperative fluctuations in serum sodium (Na+) andthe occurrence of DI.

Methods: A retrospective chart review was conducted for patients having CP resections between the years 1995 and 2000. Charts were reviewed in duplicate and perioperative data were extracted (preop to 48 hours postop). To examine fluctuations in Na+ , the preoperative Na+ and the nadir and peak Na+ within the first 24 hours following surgery were recorded (in meq/L).

Results:A total of 21 CP resections were performed in 20 patients over the 6 year period (mean age 8.6+3.9 years)Seventeen of the 20 patients (85%) developed DI within the first 24 hours postoperatively and all of these patients were treated with DDAVP. In 5 patients (25%) DI was diagnosed preoperatively and DDAVP was initiated prior to surgery. The mean Na+ prior to surgery in the patients not treated with DDAVP preoperatively was 140+2, with the nadir and peak being 134+5 and 153+7, respectively perioperatively. Na+ fluctuated by 19 meq/L+8 over 24 hours. In 3 patients (18%), Na+ fell below 130 meq/L, while in 11 (65%) it peaked at more than 150 meq/L and in 4 (24%) more than 160 meq/L.

In comparison, patients treated with DDAVP prior to surgery had a preoperative Na+ of 142+4, with the 24 hour postoperative nadir and peak being 136+4 and 148+5, respectively. The mean Na+ fluctuation across these patients was 12 meq/L+5, with only 1 patient having a Na+ below 130 meq/L and above 150 meq/L, respectively.

Conclusion: Patients treated with DDAVP prior to surgery have less fluctuation in serum Na+ suggesting a possible role for empiric preoperative or early postoperative DDAVP treatment in patients undergoing CP resection.

23 Pediatric Craniopharyngioma; Long Term Follow Up Following Aggressive Surgical Resection

AUTHORS: Jeffrey P. Blount, MD, Flavio Pulera, MD, Cynthia Cupido, MD, Patricia Rowe, RN, Tina Popov, RN, CPNP, H. J. Hoffman, MD (Toronto, Ontario, Canada), R. P. Humphreys, MD (Toronto, Ontario, Canada), J. T. Rutka, MD (Toronto, Ontario, Canada), P. B. Dirks, MD (Toronto, Ontario, Canada), J. M. Drake, MD (Toronto, Ontario, Canada)

ABSTRACT:

Background/Objective: The optimal treatment of pediatric craniopharyngioma is controversial. Aggressive surgical resection has been advocated as the preferred approach. To better understand the risks associated with this approach a single institution review was undertaken.

Methods: IRB approval was obtained. Medical records of 73 patients who underwent surgery for craniopharyngioma during the MRI era (1985-2000)were reviewed. Data included age at resection, previous surgery, size and imaging characteristics of tumor, surgical approach, intra and post operative complications, post operative imaging, recurrence and length of follow up.

Results: 73 patients underwent 107 operations. A subfrontal/pterional approach was used in 77 cases while 14 underwent an orbito-frontal craniotomy. 16 others underwent another operative approach. Of 31 patients with follow up greater than 3 years , 17/31 (54%) demonstrated no recurrence following gross total resection (surgeon impression)while 14/31 (46%) required further surgery for recurrence. Average time to recurrence for resected lesions was 840 days. All subtotally resected tumors followed more than 180 days recurred. Acute complications during the initial hospitalization

included death within one month of surgery (4/73=5.4%), stroke (6/73=8.2%), neurologic devastation (3/73=4.1%),new visual loss (2/73=2.7%) SDH/EDH(4/73=5.4%),subgaleal fluid collections requiring shunting (3/73=4.1%), infection (3/73=4.1%) and seizures (8/73=10.8%).

Conclusions: The aggressive surgical management of craniopharyngioma carries significant risk however it remains the preferred approach due to the propensity of subtotally resected lesions to recur and cause neurologic decline.

24 Aprotinin: A Pharmacologic Therapy that Reduces Blood Loss in Craniofacial Surgery

AUTHORS: Karin M. Muraszko, MD, Steven R. Buchman, MD, Hamish M. Munro, MD, Laurie J. Stricker, MD (Ann Arbor, MI)

ABSTRACT:

Purpose: The purpose of this study was to determine the efficacy and safety of Aprotinin to reduce hemorrhage and transfusion requirements in craniofacial surgery. Aprotinin is a serine protease inhibitor whose net effect on coagulation is to inhibit both fibrinolysis and platelet aggregation resulting in reduction in blood loss.

Methods: 10 consecutive children undergoing reconstructive craniofacial surgery were prospectively assigned to receive Aprotinin (Group A) intraoperatively. Following induction of general anesthesia all children received a 1 ml(1.4 mg) test dose of Aprotinin, which, if negative, was followed by a loading dose of 240mg/m2 and a continuous infusion of 56mg/m2/hr for the duration of surgery. For comparison, a control group (GroupC) included 10 consecutive children having similar surgery immediately prior to the start of the study, and a matched set (Group M)included 10 children who were identified from records and matched as to procedure, weight, and age. Statistical analysis used ANOVA and post hoc pairwise comparisons with Tukey's HSD or Dunnet C analysis where appropriate P less than 0.05 was considered significant.

Results: Both the control and matched groups had double the blood loss and transfusion volume compared to the Aprotinin group. 50% of patients in the Aprotinin group received no blodd products at all when compared to control groups.

Conclusion: The use of Aprotinin substantially reduced blood loss resulting in reduced need for transfusion and therefore, exposure to multiple blood products.

25 Multiple Revolution Spiral Osteotomy for Cranial Reconstruction; Surgical Technique and Early Results in Ten Patients

AUTHORS: Matthew N Henry, MD, Micam Tullous, MD (San Antonio, TX), Patricia Mancuso, MD (San Antonio, TX), Dennis Vollmer, MD (San Antonio, TX), Nitin Tandon, MD (San Antonio, TX)

ABSTRACT:

Introduction: We have developed a novel surgical technique, the multiple revolution spiral osteotomy, for cranial contouring of overly flattened areas of bone that is commonly seen in the biparietal area of sagittal synostosis or unilaterally in posterior plagiocephaly. Surgical technique and clinical results in ten patients who underwent cranial reconstruction utilizing this technique are presented.

Methods: Ten patients (ages 7-23 months) with sagittal synostosis or plagiocephaly were selected to undergo surgical correction utilizing this technique. The cranial vault was exposed and an appropriate bone flap(s) was turned. The multiple revolution spiral osteotomy was completed. Elevation of the spiral segments were maintained by semi-rigid fixation from application of an absorbable plating system.

Results: Ten patients were operated on and followed for a mean of 5.3 months (range 2-9 months). The follow up results of this procedure include immediate correction of cranial deformity, resolution of radiographic cerebral compression, avoidance of large areas of craniectomy, and no immediate

complications. Computed tomography obtained in three patients ranging from 4.5 to 6 months postoperatively show a consistent 70-85% re-ossification rate. This procedure allows for cranial remodeling, bone bridging, and re-ossification for production of a new smooth contour.

Conclusions: Early results show that this technique is an effective method of cranial remodeling, results in immediate correction of deformity, and avoids the production of large craniectomy defects. Long term follow up is pending.

26 Endoscopic Assisted Verses Open Strip Craniectomy for Sagittal Craniosynostosis: A Retrospective Review

AUTHORS: Donnie T. Tyler II, MD, Andrew Parent, MD (Jackson, Mississippi)

ABSTRACT: A retrospective comparison of two different techniques in the treatment of sagittal craniosynostosis employed at the University of Mississippi Medical Center between the years 1985 and 1999. From 1985 to 1996 operative exposure was obtained consisted through a single midline incision extending roughly from the anterior to the posterior fontanelle. A strip craniectomy was then performed under direct visualization. After 1996, the exposure was through two separate incisions placed in the coronal plane at the level of the lambda and bregma. The endoscope was used to assist with the subgaleal and extradural bony dissection. The placement of a post-operative molding helmet was not used with either technique. Multiple aspects of this procedure were compared: operative time, blood loss, follow up anterior-posterior / lateral ratio, and age at time of surgery.

The endoscopic assisted method resulted in lower average blood loss compared to that of the open technique, 76cc compared to 113cc. The surgical time was nearly the same for both techniques. The ICU and hospital length of stay was the same for both techniques. The average age of patients in the endoscopically assisted method was 3.5 months versus 5.2 months in the open method, and follow up AP/Lateral skull ratios were nearly equal. We conclude that this endoscopically assisted method is associated with a lower blood loss, and similar follow up AP/Lateral skull ratios without additional operative time.

27 Sagittal Craniosynostosis Outcome Assessment for Two Methods and Timings of Intervention

AUTHORS: Paul C. Francel, MD, PhD, Jayesh Panchal, MD (Dept of Plastic Surgery, Oklahoma City, OK), J. L. Marsh, MD (St. Louis, MO), T. S. Park, MD (St. Louis, MO), B. Kaufman, MD (St. Louis, MO), T. Pilgram, PhD (St. Louis, MO), S. H. Huang, (St. Louis, MO)

ABSTRACT:

Purpose: This retrospective study was conducted to determine outcome differences in cranial index (CI, cranial width/cranial length X 100) associated with either age at surgery or extent of operation.

Methods: Children less than or equal to 13 months old at surgery having computed tomography digital data pre-, peri-, and 1 year post-operatively were studied. The operation was either extended strip craniectomy or subtotal calvarectomy and age at operation was either less than or equal to 4 months or greater than 4 months.

Results: Twenty-eight patients underwent extended strip craniectomy (mean age of 5.1 months). Their mean CI preoperatively was 67, versus 71 at 1 year postoperatively (p=0.0001). Of these patients, 15 were less than 4 months old (mean age 2.9 months) and 13 were greater than 4 months old (mean age 7.6 months). Cranial indices at 1 year postoperatively did not reach the age-appropriate normal range for either of these groups, and there was significant difference between the mean percentages of improvement achieved (p = 0.143). Twelve patients underwent subtotal calvarectomy (mean age 5.2 months). Their mean CI preoperatively was 66 versus 74 at 1 year postoperatively (p=0.0001). The percentage improvement in CI 1 year after subtotal calvarectomy was greater than after extended strip craniectomy (p = 0.003).

28 Cortical Dysmorphology in Non-Syndromic Craniosynostosis

Conclusions: Extended strip craniectomy for sagittal craniosynostosis does not achieve normal CI, even when performed before 4 months of age. Subtotal craniectomy for sagittal craniosynostosis does achieve normal CI, at least when performed within the first 13 months of life.

AUTHORS: Benjamin C. P. Lee, MD, Mokhtar Gado, MD, (Saint Louis, MO), T. S. Park, MD, (Saint Louis, MO)

ABSTRACT:

Purpose: We sought to evaluate the surface topography of the cerebral cortex in patients with non-syndromic craniosynostosis.

Methods: We studied 38 patients with non-syndromic craniosynostosis, consisting of 13 sagittal, 16 coronal (12 unilateral, 4 bilateral), 6 metopic, 2 lambdoid, 1 squamous stenoses on whom 3D surface rendered MR reconstructions were obtained pre-operatively. MR scans were acquired in the sagittal plane with standard MPRAGE technique. 3D surface renderings were performed using Voxelview software using methods developed by the authors. The surface rendered images were displayed in orthogonal and multiple oblique directions and were evaluated without clinical data. The results of the observations were derived by consensus.

Results: In addition to the expected deformity of the skull and brain, the following findings were found in specific types of craniosynostoses: 1)sagittal - verticalized sylvian fissure, obliquely oriented central sulci, hypoplastic frontal lobe, and compressed parieto-occipital cortex; 2)unilateral coronal - compressed ipsilateral frontal cortex, hypoplastic frontal lobes, verticalizated sylvian fissure, antero-posteriorly displaced central sulci, abnormal generalized small gyri, and small prefrontal gyrus; 3)bilateral coronal - compressed bilateral frontal cortex, hypoplastic ipsilateral frontal lobe, and enlarged precentral sulcus; 4)metopic - hypoplastic frontal lobes and asymmetric hemispheres; 5)lambdoid - compressed cortex, and abnormal small gyri hemispheres; 6)squamous synostosis - compressed cortex.

Conclusions: 3D MR surface renderings demonstrated unique topographic appearances. In addition to the mechanical compression of the brain beneath the calvarial derformity, we postulate that there may be associated intrinsic cerebral maldevelopments.

29 Developmental Delays in Children with Non-Syndromic Craniosynostosis and Deformational Plagiocephaly

AUTHORS: Paul C. Francel, MD, PhD, Hamid Amirsheybani, MD (Oklahoma City, OK), Robin Gurwitch, PhD (Oklahoma City, OK), Vicki Cook, MEd (Oklahoma City, OK), Jayesh Panchal, MD (Oklahoma City, OK), Barbara Neas, PhD (Oklahoma City, OK), Norman Levine, MD (Oklahoma City, OK)

ABSTRACT:

Objective: The purpose of this study was to determine whether children with non-syndromic craniosynostosis (CR) and deformational plagiocephaly (DP) demonstrated cognitive and psychomotor delays when compared to a "typical" population.

Methods: This prospective study involved 21 subjects with non-syndromic craniosynostosis (mean age=10.9 months) and 42 subjects with deformational plagiocephaly (mean age=8.4 months). Each child was assessed using the Bayley Scales of Infant Development-II prior to therapeutic intervention (surgery for craniosynostosis and molding helmet for deformational plagiocephaly). The distrubution of the scores was divided into four groups: accelerated, normal, mild delay and significant delay. The distrubutions of the Mental Developmental Index (MDI) and Psychomotor Developmental Index (PDI) were then compared to a "typical" age matched population using Fisher's exact chi-square test.

Results: Within the CR group, the PDI scores were significantly different from the "typical" distribution (p = less then 0.001). In contrast, the MDI scores were not statistically different (p=0.08). For MDI, 23.9% of the subjects demonstrated delay as compared to 15% in the "typical" population. Within the DP group, both the PDI and MDI scores were significantly different from the "typical" distribution (less than 0.001). For PDI, 32.6% of the subjects demonstrated delay as compared to 12.6% in the "typical" population. For MDI, 17.4% of the subjects demonstrated delay as compared to 15% in the "typical" population.

Conclusion: This study indicates that prior to any intervention subjects with CR and DP demonstrate delays in cognitive and psychomotor development as compared to an age matched population.

30 Surveillance CT Scans in Routine Shunt Evaluation

AUTHORS: Scott W. Elton, MD, R. Shane Tubbs, MS, PA-C (Birmingham, AL), Paul A. Grabb, MD (Birmingham, AL), W. Jerry Oakes, MD (Birmingham, AL)

ABSTRACT:

Introduction: Elective outpatient ventricular shunt evaluation remains problematic, as asymptomatic patients may present with radiologic evidence of progressive ventricular enlargement. This may suggest "presymptomatic" shunt dysfunction. An area which has not been well explored in the literature is the utility of performing routine surveillance CT scans. Although a number of studies state varying protocols for performing follow-up CT imaging, none has addressed surgical intervention on asymptomatic patients with progressive ventricular enlargement. We reviewed our experience with routine surveillance scans to determine the incidence of asymptomatic shunt dysfunction in our patients.

Methods: A retrospective chart review of all patients seen from January through July 2000 in our clinics who received a routine scheduled surveillance CT to evaluate shunt function.

Results: Of 109 routine consecutive scans, 8 revealed increased ventricular size in asymptomatic patients as compared to prior CT scans. 4 of 8 (50%) were in children with myelodysplasia. 6 of 8 (75%) underwent elective revision within one week, while the other 2 patients chose observation after careful discussion between the attending physician and the family. All 6 operated upon had no 30 day morbidity from their shunt revision, but had no clear clinical improvement.

Conclusion: Since shunt dysfunction can be devastating to an individual, serial imaging of children with shunts may be important. The literature has not addressed the utility of routine imaging. Our results suggest that routine scans do have utility, being able to detect progressive ventricular enlargement in asymptomatic children. This allows for timely and elective shunt revision.

31 The application of Controlled, Iatrogenic Intracranial Hypertension in Slit Ventricle Syndrome Patients with Shunt Malfunction

AUTHORS: William E. Butler, MD, Saad Khan (Montreal, Quebec, Canada), Paul H. Chapman, MD (Boston, MA)

ABSTRACT:

Introduction: When a shunted patient with slit-ventricle syndrome presents with a shunt malfunction, the lateral and particularly the third ventricle may not be of sufficient caliber, despite the shunt malfunction, to allow atraumatic passage of an endoscope to the floor of the third ventricle. The selection of a narrower endoscope may increase the navigability of the ventricles, but at the cost of reducing the image quality and the diameter of the instrument port. Alternatively, the ventricles may be iatrogenically enlarged by the gradual, controlled application of intracranial hypertension via an external ventricular drain (EVD).

Methods: Three slit ventricle syndrome patients with 24, 12 and 18 prior shunt revisions presented each with shunt infection. One patient had undergone a prior attempt at endoscopic third ventriculocisternostomy (ETV) which was aborted because the ventricles were too narrow to accept an endoscope atraumatically. In each patient the shunt was externalized and intracranial hypertension was applied gradually (mean of 8.3 days) until follow-up CT showed the ventricles to be of sufficient size to permit ETV. After the procedure, the EVD was weaned and removed over mean 4.6 days.

Results: ETV was satisfactorily performed in these three patients, whom each remain shunt free (mean follow-up 11.7 months).

Conclusion: The controlled, gradual application of intracranial hypertension under close neurologic observation can afford an opportunity for ETV by enlarging the ventricles in selected patients with slit-ventricle syndrome.

32 Infection Rates in the Treatment of Loculated Hydrocephalus with Endoscopic Fenestration

AUTHORS: Renatta J. Osterdock, MD, Stephanie L. Einhaus, MD, Michael Muhlbauer, MD, Frederick Boop, MD, Robert A. Sanford, MD, (Memphis, TN)

ABSTRACT: Loculated ventricles represent a substantial challenge in the treatment of children with hydrocephalus. With a growing population of children with complex shunt systems, endoscopic fenestration is receiving increasing attention as a tool in the treatment of these patients. Little has been reported in the literature regarding the infection rates associated with using the endoscope in shunt placement. We conducted a retrospective review of 50 consecutive patients treated using endoscopic fenestration or guidance for complicated ventricular systems in conjunction with the placement or revision of a shunt system over the past 5 years. A total of 174 procedures were performed in these 50 patients with an average of 3.5 per patient (range 1-14). Sixty-nine procedures were performed with the endoscope and 105 without the endoscope. Diagnoses included IVH of prematurity (20, 4 with meningitis), congenital hydrocephalus (10), tumor(6), spina bifida (4), post-infectious (3), Dandy-Walker (2), other (5). There were two deaths during the study period of unrelated causes. Infection rates were closely reviewed. A total of 8 infections occurred. Four were in the endoscopic group(5.8%) and 4 in the non-endoscopic group (3.8%). Our institutional infection rates during that time period ranged from 4.7 to 5.9% for all shunts. The operative time was significantly increased when the endoscope was used. In this group of patients endoscopy is associated with a higher infection rate, however, the increase does not outweigh its usefulness.

33 Death Following Delayed Failure of Third Ventriculostomy: A Report of 3 Cases

AUTHORS: Walter J. Hader, MD, FRCS(c), Jim Drake (Toronto, Ontario), Doug Cochrane (Vancouver, BC), John Kestle (Salt Lake City, UT), Owen Sparrow (England)

ABSTRACT: Delayed failure following successful third ventriculostomy (TV) for obstructive hydrocephalus is rare. Death as a consequence of failure of a third ventriculostomy has never been reported. We present 3 patients who died as a result of increased intracranial pressure following delayed failure of a third ventriculostomy.

The hospital records at the Hospital for Sick Children, British Columbia's Children's Hospital and Southhampton General Hospital were searched for patients who died after having a third ventriculostomy for obstructive hydrocephalus. Patients records were obtained and the following data recorded: diagnosis, age at time of TV, previous treatment, technique of third ventriculostomy, clinical and radiological follow up, time from TV till death and results of neuropathological examination.

Three patients were identified. A 13 year old girl with NF type I underwent TV for obstructive hydrocephalus secondary to a tectal lesion. Three years later she deteriorated rapidly over 6 hours and was found dead at home. A 4 year old boy treated with TV for aqueductal stenosis presented 2

years postoperatively to an emergency with symptoms of increased ICP. The symptoms were discounted in the absence of a shunt and while under observation he acutely deteriorated and died. A 10 year old patient with previous VP shunt for aqueductal stenosis underwent TV and shunt removal. Six months after the procedure he deteriorated with evidence of raised ICP, had emergent insertion of a VP shunt, but remained vegetative and died of complications. Neuropathological exam demonstrated that the third ventriculostomy was not patent and there was evidence of increased ICP in two cases.

Late failure of third ventriculostomy resulting in death is a rare and previously unrecognized complication. Delay in recognition of recurrent ICP symptoms and a false sense of security by family and caregivers because of the absence of a shunt and their thinking that the hydrocephalus has been cured may contribute to fatal complications after third ventriculostomy.

34 Long-Term Control of Hydrocephalus Associated with Presumed Benign Gliomas of the Midbrain by Endoscopic Third Ventriculostomy

AUTHORS: Curtis J. Rozzelle, MD, Paul A. Grabb, MD (Birmingham, AL)

ABSTRACT:

Introduction: We report eight children with presumed benign gliomas of the midbrain and hydrocephalus to evaluate the efficacy and durability of endoscopic third ventriculostomy (ETV) to control their hydrocephalus.

Methods: Children presenting with hydrocephalus and magnetic resonance imaging consistent with glioma of the tectal plate (n=7) or aqueduct (n=1) underwent ETV for treatment of hydrocephalus. Eight children (ages 4 to 14 years, mean 9.4 years) underwent 9 procedures. ETV was performed through a coronal burr hole using a rigid scope. Perforation of the third ventricular floor was performed with various instruments and expanded with a #2 Fogarty balloon.

Results: All children had resolution of hydrocephalus by imaging, symptoms, and signs. One child presented 6 months after ETV with recurrent hydrocephalus, underwent repeat ETV, and has had his hydrocephalus controlled for 54 months. The initial ETV was deemed technically inadequate. Median follow-up is 51 months for these eight children. There were no operative complications. One child has shown slight progression in tumor size. All other tumors have remained unchanged.

Conclusions: All of our children presenting with hydrocephalus from presumed midbrain gliomas had successful treatment of their hydrocephalus with a median follow-up of over 4 years. Given that 32% of ventriculo-peritoneal shunts have complications within the first year according to the shunt design trial, children presenting with hydrocephalus from a presumed benign glioma of the midbrain should be treated with ETV. In experienced hands this is an effective and durable treatment with very low morbidity for this select patient population.

35 Novel Findings in the Development of the Normal and Tethered Filum Terminale

AUTHORS: Ketan R. Bulsara, MD, Thomas J. Cummings, MD (Durham, NC), Roger E. McLendon, MD (Durham, NC), Herbert E. Fuchs, MD (Durham, NC), Timothy M. George, MD (Durham, NC)

ABSTRACT:

INTRODUCTION: The embryopathy underlying tethering of the filum terminale is poorly understood. We utilized a battery of developmental and structural immunohistochemical markers as a basis to define the pattern of normal development of the filum then compared this staining pattern to filum associated with tethering or spinal dysraphism.

Methods: Control fila were obtained at autopsy from patients with no known history of tethered cord syndrome and from patients undergoing dorsal rhizotomy for spasticity. All were grossly normal and sectioned at 0.5 cm intervals from the conus. The fila were confirmed histologically and

immunostained with structural and caudal developmental markers. Thirty-four cases of fila from tethered cord patients underwent the same battery of markers and were compared to controls.

Results: All structural markers revealed a predictable pattern of staining in control and diseased specimens. Interestingly, the developmental markers revealed a stereotypic dorsoventral and rostrocaudal expression pattern in the normal control fila that was altered in the dysraphic and tethered fila.

Conclusions: Putative features of normal filum development were described that was deranged in filum associated with tethering and spinal dysraphism. These findings suggest that the filum is abnormally formed and the altered expression affects cellular migration and/or cellular identity which may lead to the syndrome of the tethered spinal cord.

36 The Relationship of Malformation Anatomy to Deterioration Patterns in Patients with Transitional Lipomyelomeningocele

AUTHORS: David D. Cochrane, MD FRCS(c), Christian Finley, MD, John Kestle, MD (Salt Lake City, UT), Paul Steinbok, MBMS (Vancouver, British Columbia, Canada)

ABSTRACT:

Objective: Determine the relationship of malformation anatomy to the pattern of functional deterioration observed after successful untethering in patients with transitional lipomyelomeningocele.

Methods: Fifty patients having transitional LMMC, treated at a single institution were retrospectively reviewed to determine the relationship of their clinical status prior to and following untethering and the anatomical relationship of the neural placode in the subarachnoid space.

Results: 82% of patients were diagnosed prior to one year of age. Twenty-two patients were considered normal at presentation and 28 showed abnormalities on clinical examination. Forty-nine patients were untethered successfully and all were available for follow-up (mean 39 months).

Central malformations occurred in 24 patients and lateral malformations in 26. Prior to untethering, if symptomatic, and at the time of deterioration, patients with central malformations tended to exhibit bilateral deficits and those with lateral lesions, asymmetrical, unilateral deficits usually on the side of lateralization.

The 50%ile time to deterioration in patients with lateral malformations was approximately 30 months and 95 months for those with central malformations. These differences in time to deterioration did not reach statistical significance.

Conclusions: Functional loss after untethering is in part a reflection of the ability to detect neurological, orthopaedics and urological abnormalities in infant populations however the pattern of functional loss is also predicted by the preoperative malformation anatomy. Post-untethering deterioration in patients with central malformations is manifest by bilateral symptoms and signs while those with lateralized malformations deteriorate with ipsilateral signs and symptoms.

37 Split-Cord Malformations Associated with Distal Tethering in Children: Is Untethering Indicated?

AUTHORS: David Hart, MD, Hulda Magnadottir, MD (Lebanon, NH), Mark Krieger, MD (New York, NY), J. Gordon McComb, MD (Los Angeles, CA), Michael Levy, MD (Los Angeles, CA)

ABSTRACT: It is documented that untethering of a thickened filum fails to reverse progressive scoliosis. To evaluate this we reviewed our series of patients with split cord malformations over ten-years. Of 32 patients, 20 had split cord malformations with distal tethering.

There were 17 females and 3 males (mean age at presentation =6.4 + 4.5 yrs). Seven had fatty filums and 2 had lipomatous malformations. Split cord malformations were thoracic (1), lumbar (4), thoracolumbar (1), lumbosacral (5) level, and multilevel (8). No patients had associated Chiari I malformations or hydrocephalus. Mean follow-up was 5 + 2.7 years.

Presenting signs/symptoms included lower extremity deformities in 4 (1 bilateral), scoliosis in 4, and scoliosis with lower extremity abnormalities in 4. One had an associated hip abnormality. Normal exams were present in 12. Preoperative bladder function was abnormal in 2 children and neither had improvement following surgery.

Ten patients had neurologic deficits on presentation. Postoperatively 5 improved, 3 remain unchanged, 1 was worse and 1 had transient weakness. Surgical complications included 1 transient pseudomeningocele (with leakage and subsequent infection), 1 ischemic cord injury, and 1 superficial wound infection.

Split cord malformations are frequently associated with motor compromise, bladder compromise or tethering at presentation. Preoperative motor abnormalities can be improved in a number of patients following surgical intervention whereas preoperative bladder abnormalities are less likely to be reversed. Association of split cord malformations with tethering did not impact on postoperative function and only one patient required instrumentation for treatment of scoliosis following untethering.

38 The Tethered Cord Syndrome: Urodynamic Evidence of Improved Outcome with Early Untethering

AUTHORS: Andrew S. Youkilis, MD, Hong Jin Suh, MD (Ann Arbor, MI), Harry Koo, MD (Ann Arbor, MI), David A. Bloom, MD (Ann Arbor, MI), Karin Muraszko, MD (Ann Arbor, MI)

ABSTRACT: Urologic dysfunction is common in patients with Tethered Cord Syndrome(TCS). In order to determine whether early untethering can prevent the development of urologic symptomatology, we retrospectively reviewed urodynamic records of 82 children with TCS who underwent spinal cord untethering from February 1990 to March 1999. Each patient was evaluated with pre and postoperative cystometrogram(CMG), cystourethrogram(VCUG) and serial renal ultrasound(U/S). Of 50 patients evaluated to date, 21 patients presented with primary cord tethering(Group I). The other 29 patients presented with secondary tethering following previous myelomeningocoele repair(Group II). In Group I the majority of patients presented with flat preoperative CMG, absence of reflux on VCUG and no evidence of hydronephrosis on U/S. Postoperative urodynamics revealed stable filling pressures without progression on CMG in all but two patients. There was evidence of benefit with improvement of reflux in three of four patients and improved hydronephrosis in three of five cases. There was only one case of worsening bladder compliance. In Group II, preoperative CMG, VCUG and Renal Ultrasound showed abnormalities in 80%, 40% and 47% of our series. There was improvement in 75% of Group II patients with abnormal preoperative CMG. Vesicoureteral reflux and hydronephrosis did not appear to improve postoperatively. This study provides further evidence that early untethering in patients with TCS is safe and effective at preventing urodynamic worsening. It clarifies that our ability to prevent urologic symptomatology continues to be better than our ability to reverse urologic abnormalities once already present.

39 The Natural History of Tethered Cord in Patients with Myelomeningocele

AUTHORS: Loi K. Phuong, MD, Corey Raffel, MD (Rochester, MN), Kimberly Schoeberl, RN (Rochester, MN)

ABSTRACT:

Objective: The purpose of this study is to look at the natural history of tethered cord in patients who have undergone myelomeningocele repair.

Methods: This retrospective study reviewed records of myelomeningocele patients between 1976-1997. We identified 45 patients who had myelomeningocele repaired and later underwent orthopedic correction of flexion contractures and leg deformities or bladder augmentation and had at least 1 year of follow-up. The mean follow-up is 12.2 years (range 1-41 years) from the time of initial

orthopedic correction of leg deformity or bladder augmentation. None of the patients underwent spinal cord untethering during the follow-up period.

Results: Forty (88.9%) of 45 myelomeningocele patients who underwent bladder augmentation or orthopedic correction of leg deformity subsequently required further surgical procedures for the treatment of complications due to tethered cord (ie., contracture release, spinal fusion for scoliosis, osteotomy, or bladder augmentation). The mean age at the time of the first orthopedic procedure is 4.7 years (range 1-20 years old), while the mean age at the time of first bladder augmentation is 12.5 years (range 5-16). The incidence of progression of tethered cord syndrome is 27.5%, 40%, and 60% at 1, 2, and 5 years, respectively.

Conclusion: Patients who have undergone myelomeningocele repair and later bladder augmentation or orthopedic correction of leg deformities are at high risk of developing further complications due to spinal cord tethering. In patients with progressive neurologic impairment or orthopedic deformities, untethering should be strongly considered.

40 Reliability of Intraoperative Electrophysiological Monitoring in Selective Posterior Rhizotomy

AUTHORS: Sandeep Mittal, MD, Jean-Pierre Farmer, MD (Montreal, PQ), Chantal Poulin, MD (Montreal, PQ), Kenneth Silver, MD (Montreal, PQ)

ABSTRACT:

Background: Selective dorsal rhizotomy is a well-established treatment for spasticity associated with cerebral palsy. Most centers depend on responses to electrical stimulation of dorsal rootlets. However, there has been some controversy regarding the reliability of intraoperative stimulation. The purpose of this study was to determine whether electromyographic and physiotherapy motor responses to dorsal root stimulation were reproducible.

Methods: A series of 77 patients with spastic cerebral palsy underwent selective dorsal rhizotomy at a single center. The dorsal roots from L2 to S2 were stimulated to determine the threshold amplitude. The roots were then stimulated at four times the highest threshold with a 1-second 50-Hz train. A second stimulation run of the entire dorsal root was carried out prior to division of the root into 3 to 7 rootlets. Rootlets were individually stimulated and sectioned according to extent of abnormal electrophysiological spread. Motor responses were recorded by both surface electrodes and a physiotherapist and assigned a grade of 0 to 4+ as described by Phillips and Park. Grade difference between the first and second stimulation trains for 752 roots was determined.

Results: Statistical analysis demonstrated a clear consistency between stimulation runs both in the electromyographic and physiotherapy motor responses. Over 90% of dorsal roots had either zero or one grade difference between the two trials.

Conclusion: This study suggests that currently used techniques are reproducible and reliable for "abnormal" rootlet selection. Intraoperative electrophysiological monitoring along with physiotherapy motor response assessment can be valuable in achieving a balance between elimination of spasticity and preservation of underlying strength.

Scientific Oral Abstracts

41 Long Term Functional Outcome for Children Treated with Selective Dorsal Rhizotomy for Spasticity

AUTHORS: Shabbar Danish, BS, Susan Guzzardo, PT (New York, NY), Linda Velasquez, MS (New York, NY), I.R. Abbott, MD (New York, NY)

ABSTRACT:

Introduction: This study investigates the long-term functional impact of selective dorsal rhizotomy (SDR) on children with spastic cerebral palsy. Patient Population: All patients had spastic cerebral palsy. All underwent surgery during childhood (ages 2-11) by the senior author (IRA).

Methods: 47 patients were interviewed using the WeeFIM, a validated tool for assessing functional abilities. Functional quotients (patientÕs average scores divided by score age matched control) were then calculated for each patient preoperatively, at age 10, and at present.

Results: 47 patients were contacted. 3 patients had passed away. 2 patients were unwilling to participate in the study. Of the remaining 42 patients, the mean follow up period was 136.7 months (range 87-171 mo). The mean preoperative functional quotient was 0.57 (range 0.15-1.24); the mean at age 10 was 0.67(range (0.17-1.0); and the mean at follow up was 0.7 (range (0.15-1.0). 8/42 patients experienced either no change or worsening. 5 of these had little or no locomotive ability, 2 had marked weight gain in association with their functional decline and one scored off the top of the functional index pre-operatively. The most dramatic improvements occurred in children who crawled but did not walk preoperatively. None of the 42 children experienced worsening in scores between 10 years of age and present.

Conclusion: Children with mild to moderate spastic cerebral palsy undergoing SDR experience improvement in function as determined by WeeFIM scores and there was no evidence of late deterioration after onset of puberty.

42 Operative Complication Rate of Baclofen Pump Therapy in Pediatric Patients: Results of 48 Patients Followed at a Single Center

AUTHORS: Nathan C. Avery, MD, Marion L. Walker, MD (Salt Lake City, UT)

ABSTRACT:

Introduction: There has been a recent increase in the number of patients treated for spasticity with implantable baclofen pumps. Studies have shown that this appears to be beneficial, with variable control of the patients tone and improvements in the Ashworth scores of patients undergoing pump placement. We report the complication rate of 48 consecutive patients followed at a single center that received baclofen pump implantation for control of spasticity.

Methods: This is a single center, retrospective review that addresses complications that required operative intervention in the pediatric population. 48 patients were followed over a period of 45 months, for total of 580 months of follow up.

Results: 12 patients required some type of operative revision of the pump, for an overall complication rate of 25%. There were a total of 23 procedures done on the patients that required operative revision. Two patients required five or more procedures. There was an 8% (four patients) infection rate. Seven (15%) of the patients required revisions to correct catheter displacement or kinks, and one patient (2%) had a wound hematoma at the operative site. Two children required shunting for control of CSF fistulas. There were no mortalities related in the patients we have followed.

Conclusions: Although the results of intrathecal baclofen therapy are thought to be beneficial, there is a relatively high rate of complications that require operative treatment in the pediatric population. Counseling parents preoperatively with this data is important, and we discuss techniques that we have devised for minimizing complications.

43 Subfascial Implantation of Intrathecal Baclofen Pumps in Children

AUTHORS: Howard L. Weiner, MD, Brian Harris Kopell, MD (New York, NY), Debra A. Sala, MS, PT (New York, NY)

ABSTRACT:

Objective: Indwelling intrathecal drug-delivery systems are becoming increasingly important as a method of neuromodulation within the nervous system. Intrathecal baclofen therapy, in particular, has shown efficacy and safety in the management of spasticity and dystonia in children. The most common complications leading to the explantation of the pumps are infection and breakdown at the pump implantation site. The pediatric population poses particular challenges with regard to these complications, as appropriate candidates for intrathecal baclofen therapy are undernourished with weakened immune systems and insufficient soft tissue mass to cover a subcutaneously implanted baclofen pump. We report a novel technique of subfascial implantation which provides more substantial soft tissue coverage of the pump, reducing the potential for skin breakdown and improving the cosmetic appearance of the implantation site. Furthermore, the subfascial environment, with its greater degree of blood supply and immune surveillance, decreases the incidence of local pump infections, the most common complication leading to explantation.

Methods: Eighteen consecutive children, average age of 8 years 7 months, with spasticity and/or dystonia underwent subfascial implantation of a baclofen pump. Their mean weight was 42.9 pounds, which is less than the expected weight for a group of children of these ages.

Results: No infection or skin breakdown occurred at the pump surgical site at an average follow-up of 10.7 months.

Conclusion: The subfascial implantation technique appears to reduce the rate of local wound and pump infection while providing optimal cosmetic results.

44 Targeted Program of Parent Education at the Time of a Child's Birth can Significantly Reduce the Incidence of Shaken Baby Syndrome: The Western New York Experience

AUTHORS: Mark S. Dias, MD, FAAP, Paula Mazur, MD, FAAP (Buffalo, NY), Veetai Li, MD (Buffalo, NY)

ABSTRACT: Shaken Baby Syndrome (SBS) is one of the most lethal forms of child abuse. Although previous research has suggested that educational campaigns can increase public awareness, no study has yet demonstrated that parent education can reduce the incidence of SBS. We hypothesized that SBS represents a momentary lapse in control from a caregiver, most commonly a parent or boyfriend; most parents already know about the dangers of shaking/impact, but need to be reminded at the appropriate time ? upon the birth of a baby; and therefore a targeted effort that educates all parents, upon the birth of every child, might effectively reduce the incidence of SBS. In December 1998, we began a campaign to educate parents of all newborn infants in an 8 county region, before they left the hospital, about SBS. Parents (mothers and fathers) were asked to read a brochure about SBS and sign an affidavit acknowledging their understanding of the material. Most parents also viewed a short video. Sixteen of 17 regional hospitals participated. Thus far, 8,126 affidavits have been analyzed; 90% were signed by mothers and 74% by fathers. Over 90% of respondents acknowledged that they already were aware of the dangers of violent infant shaking; 92% thought that all parents should receive such information.

Historically, the average regional incidence of SBS in WNY is 6.5 cases per year (range 4-8). Thus far, 21 months into the program, only 2 children born since the programÕs inception have been identified as victims of SBS, representing an 82% reduction. Results accrued at 24 months will be presented. We conclude that a targeted program of universal parent education at the time of an infantÕs birth can significantly reduce SBS.

45 NonAccidental Pediatric Head Trauma: Diffusion Weighted MRI Findings

AUTHORS: Daniel Y Suh, MD, PhD, Patricia Davis, MD (Atlanta, GA), Kara Hopkins, MD (Atlanta, GA), Nancy Fajman, MD (Atlanta, GA), Timothy Mapstone, MD (Atlanta, GA)

ABSTRACT:

Introduction: Diffusion-weighted imaging (DWI) has proven a major advantage in the early detection of non-hemorrhagic infarction in children. DWI may reveal superimposed post-traumatic infarction not apparent on conventional CT or MRI. We evaluated the diagnostic utility of DWI in children with non-accidental head trauma (NAHT).

Methods: We retrospectively reviewed all children less than 2 years of age with a confirmed or suspected diagnosis of NAHT who completed a DWI within 10 days of their date of injury. Twenty children were enrolled: 18 children with confirmed NAHT and 2 children with suspected NAHT. Conventional MRI sequences as well as DWI and ADC (apparent diffusion coefficient) maps were evaluated.

Results: There were 9 boys and 11 girls; the median age was 5.0 months. Sixteen of the 18 children with confirmed NAHT (89%) demonstrated DWI/ADC abnormalities as compared to none of the children with suspected abuse. DWI revealed more extensive brain injury than predicted or showed injuries not seen based on conventional MRI in 81% (13/16) of cases. DWI combined with ADCs allowed better delineation of the extent of white matter involvement that was not well-visualized on conventional MRI. DWI/ADC abnormalities in the NAHT children had a high proclivity to involve the posterior aspects of the cerebral hemispheres (68.7%) with relative sparing of the frontal or temporal poles.

Conclusions: DWI has broad application in the early detection of non-hemorrhagic infarction in children with NAHT and enhances the sensitivity of conventional MRI.

46 A Prospective Study of an Out-Patient Management Scheme for Children with Minor Head Injuries (GCS 13-15) and No Radiographically Visible Intracranial Injuries

AUTHORS: Mark S. Dias, MD, FAAP, Kathleen A. Lillis, MD, FAAP (Buffalo, NY), Carmen Calvo, MD (Buffalo, NY), Veetai Li, MD (Buffalo, NY)

ABSTRACT: The management of children with minor head injuries has evolved. Whereas these children previously were admitted (with or without a CT scan) for observation, retrospective studies suggest that these children might be safely, and more efficiently, managed with a protocol that combines initial CT scanning, a brief observation period in the Emergency Department, and discharge to home.

We prospectively evaluated all minor head injured children 24 months and older according to a standardized protocol. Children meeting prospectively established clinical criteria underwent immediate CT scans and observation in the emergency department. Those having no radiographic intracranial injury and meeting established discharge criteria were released to home supervision. Clinical outcomes, family satisfaction, and management costs were evaluated.

Over 18 months, 214 children met entry criteria. Falls (54%) and motor vehicle accidents (13%) were the most common mechanisms of injury. A sustained loss of consciousness was recorded in 40%, and amnesia in 49%. Repeated vomiting occurred in 45% of children, 51% having 3 or more episodes. Skull fractures were rare (3%). No complications or neurological deterioration occurred during follow-up. Two children were re-evaluated within 48 hours for recurrent headache and vomiting without change in neurological condition. Both had normal repeat CT scans, and both quickly and fully recovered. Follow-up phone surveys with a subset of 27 families suggested universal satisfaction with this management scheme. The study cohort was compared with a randomly selected historical control group of children previously treated with routine CT scan and admission for observation; no differences were found in any clinical variables, but statistically significant cost savings were realized in the study population. We conclude that a management scheme utilizing initial CT scans and a brief observation period is safe, cost effective, and readily accepted by families.

47 Decompressive Craniectomy—The Second-Tier Therapy of Choice in the Treatment of Uncontrollable Post-Traumatic Intracranial Hypertension in Children?

AUTHORS: Waltraud Kleist-Welch Guerra, MD, Michael R. Gaab, MD, PhD (Hanover, Germany), Wolfgang Wagner, MD (Mainz, Germany)

ABSTRACT:

Introduction: The increase of treatment-refractory pressure following severe closed head injury with no evidence of operable hemorrhages still presents an insoluble problem in the management of these patients.

Methods: In a prospective study since 1977 until now, 31 children out of 63 patients with traumatic brain injury underwent decompressive craniectomy. The clinical status of the patients, CAT scans and ICP values were documented prospectively in a standard protocol. Primary brain or brain stem injury with fully developed bulbar brain syndrome were contraindications to decompressive craniectomy. A positive indication for decompression was given in the case of progressive therapy-resistant intracranial hypertension in correlation with clinical and electrophysiological parameters and with findings on CAT scan. Unilateral decompressive craniectomy was performed on 15 patients and bilateral craniectomy on 16 patients. In all cases, a wide fronto-temporo-parietal craniectomy was followed by a dura enlargement covered with temporal muscle fascia.

Results: The outcome, especially in children was surprisingly good. Only 2 patients (6.5%) died. Three patients (9.7%) survived, but remained in a persistent vegetative state. Five patients (16.1%) survived with a severe permanent neurological deficit, and twenty patients (64.5%) attained social rehabilitation. One patient (3.2%) did not have a follow-up examination. The GCS on the first day posttrauma and the mean ICP turned out to be the best predictors for a good prognosis.

Conclusions: Surgical decompression should be routinely performed when indicated before irreversible ischemic brain damage occurs, especially in children.

48 Neurologic Ski Injuries in Children: Morbidity Assessment and the Impact of Ski Helmet Use in a Study of Skiing Children

AUTHORS: John B. Harris, MD

ABSTRACT:

Purpose: The efficacy of ski helmets has been questioned. The purpose of this study was to prospectively investigate this neurologic paradox, at/near the site of injury.

Methods: Care was provided to 83 injured skier children (ages 3-18) at an Alpine Hospital. Data collected included skier skill, experience, hill complexity, as well as extent of injury and whether or not a helmet's use reduced neurologic injury.

Results: Of 83 Alpine Skier children, 88% experienced cerebral concussion/contusion. 11% required at least one neurosurgical procedure. 7 required emergency craniotomy, 2: emergency spinal decompression/fusion. Shortest time between injury to surgery was 30 minutes. 16 also required immediate general, orthopedic, plastic or oral surgery. Only 2 children were wearing helmets. Without helmets, both would have incurred extreme injuries, neurosurgery. Neither required neurosurgery, despite the fact that they had sustained injury on the more demanding slopes, skiing at greater speeds than those children without helmets. In contrast, children skiing slower, on less demanding terrain required 7 immediate on site craniotomies. Others without helmets, less acute, required neurosurgery on transfer.

Conclusion: In this prospective on-site series, children skiing without helmets sustained penetrating brain injuries and brain hemorrhage requiring prompt, extensive surgery. The marked disparity in injury, between skiers with and without helmets, is more graffically clear when observations are made at the ski areas. Neurosurgical presence at alpine competitive sites may reduce child skier mortality and morbidity. Locating child ski competition near such resource may be a factor to consider

where skier children is concerned. In summary, there is a glaring difference in frequency and severity of injury between those children skiing with helmets and those children without.

49 Variability in the Definition and Treatment of SCIWORA: A Survey of Pediatric Neurosurgeons

AUTHORS: Mei Wong, MD, Mark S. Dias, MD, FAAP (Buffalo, NY), Veetai Li, MD (Buffalo, NY)

ABSTRACT: We hypothesized that there is significant variability in the diagnosis and treatment of SCIWORA among practicing pediatric neurosurgeons. We sent a survey to 279 members of the ASPN and Joint Pediatric Neurosurgical Section of the AANS/CNS; 57 evaluable responses (20%) were returned. SCIWORA was grouped into ten clinical-radiographic scenarios (designated A through J): permanent objective motor deficits with (A) or without (B) MRI abnormalities; permanent objective sensory deficits with (C) or without (D) MRI abnormalities; transient objective motor deficits with (E) or without (F) MRI abnormalities; transient objective sensory deficits with (G) or without (H) MRI abnormalities, and transient subjective sensorimotor disturbances with (I) or without (J) MRI abnormalities.

There was marked variability among respondents in several respects. For example, the minimum definition of SCIWORA required by respondents was: scenario A (3% of respondents), B (5%), C (0%), D (2%), E (7%), F (21%), G (2%), H (16%), I (16%), J (28%). Hospitalization was recommended most frequently in scenario A (100% of respondents), and least in scenario J (37%). The use of cervical orthoses was highly variable. Cervical orthoses were most frequent in scenario A (98%) and least frequent in scenario J (19%). The duration of immobilization ranged from 0 to 36 weeks, depending upon the scenario. Both gym activity and contact sports restrictions varied from none to lifetime. Detailed analyses between groups will be presented and compared. We conclude that there is marked variability among clinicians regarding both the definition of SCIWORA and its treatment.

50 A Prospective Study of the Utility of MRI in the Diagnosis and Treatment of Transient Neurologic Deficits Following Spinal Cord Injury in Children

AUTHORS: Susan R. Durham, MD, Albert Telfeian, MD (Philadelphia, PA), John Boockvar, MD (Philadelphia, PA), Peter Sun, MD (Oakland, CA)

ABSTRACT:

Introduction: The treatment of transient neurologic deficits following spinal cord injury in children in the absence of radiographic abnormality remains controversial. We report a prospective study of the utility of MRI in the diagnosis and treatment of such injuries.

Methods: All children admitted following suspected spinal cord injury with normal lateral c-spine x-rays were evaluated with MRI. If the MRI was negative, these children were placed in hard collar immobilization and re-evaluated with flexion/extension lateral c-spine x-rays at 2 weeks following injury. Collar immobilization was discontinued at that time in the presence of normal dynamic x-rays, normal neurologic exam, normal range of motion, absence of neck pain and resolution of prior symptoms.

Results: Fourteen children (10 male, 4 female) ranging in age from 7 to 15 years (mean 11.3 +/- 2.6 years) were studied. Thirteen of these injuries were sports-related. Six children had abnormal neurologic exams upon admission of which motor loss in the upper extremities was most common. The duration of symptoms averaged 25.4 +/- 39.5 minutes (range 5 minutes to 5 days). Follow-up dynamic x-rays were normal in all children at 2 weeks following injury. At last follow-up (6.6 +/- 10.6 weeks), all children were normal neurologically and without neck pain or limitation in cervical spine motion.
Conclusion: Transient neurologic deficits following spinal cord injury in the absence of MRI abnormality may be safely treated with a minimum of 2 weeks of hard collar immobilization in select cases.

51 MRI Clinical Correlation in Spinal Cord Injury without Radiographic Abnormality in Children

AUTHORS: Amos O Dare, MD, Veetai Li, MD (Buffalo, NY), Mark S. Dias, MD (Buffalo, NY)

ABSTRACT:

Purpose: To study spinal cord MRI findings associated with the various clinical syndromes in children with SCIWORA.

Methods: We retrospectively reviewed the records of 23 patients presenting with SCIWORA to the Children's Hospital of Buffalo between 1991 ? 1999. Neurological syndromes were correlated with results of MRI of the spinal cord obtained within 24 hours of presentation using conventional imaging sequences on 1.5-telsa magnet.

Results: Neurological syndromes on presentation were either complete (Frankel grade A, 9.52%), severe, partial (Frankel grade C, 4.35%), or mild, partial (Frankel grade D, 86.96%). The majority of partial neurological deficits (73.91%) resolved within 72 hours; in 4 patients (17.39%), partial deficits lasted more than 72 hours.

MRI was obtained in 17 of 21 patients presenting with partial neurological deficits. Neural and extraneural elements were normal in all 17 patients. Of particular interest, MRI was also normal in 4 patients with partial motor deficits lasting more than 72 hours. In the 2 patients with complete neurological syndromes, MRI revealed spinal cord contusion in one patient and spinal cord edema in the other.

Conclusion: In our experience, the predominant neurological presentation in SCIWORA was a mild, partial syndrome that resolved within 72 hours. MRI was abnormal only in those patients with complete neurological deficits. These findings suggest that in the acute setting, conventional MRI may lack the sensitivity to demonstrate spinal cord injury radiographically in the setting of partial or temporary neurological deficits associated with SCIWORA, even when deficits persist beyond 72 hours.

52 Avulsion Transverse Ligament Injuries in Children: Successful Treatment with Non-Operative Management

AUTHORS: Patrick Lo, MD BSc(Med) FRACS, Peter Dirks, MD (Toronto, Ontario, Canada), James Drake, MD (Toronto, Ontario, Canada), Douglas Hedden, MD (Toronto, Ontario, Canada)

ABSTRACT: Neck injuries in children most commonly affect the upper cervical spine. Injuries of the transverse ligament and its attachments may result in C1-C2 instablility, but the optimal form of treatment is unknown. The authors have reviewed the clinical course of three patients, aged between 5 and 9 years, who were diagnosed with transverse atlantal ligament injuries. In each case, the integrity of the transverse ligament was compromised as a result of a unilateral avulsion fracture of its bony tubercle. In adults, these rare injuries have been classified by Dickman and Sonntag as type IIb transverse ligament injuries (Neurosurgery 38:44, 1996) and operative treatment has been required because of nonunion after external immobilization.

In our series, one child was injured as a result of a fall and two were unrestrained in motor vehicle accidents. All presented with neck pain, but no neurological deficit. Plain films did not demonstrate the injury but CT scans were performed because of significant pain. MRI showed evidence of soft tissue injury in the occipital-C1-C2 ligamentous complex.

All children were managed with external immobilization, using halo vest in two cases and a SOMI brace in one, for 12 weeks. They were investigated post-immobilization with plain films and/or CT scan. CT demonstrated reattachment of the avulsed bony tubercle whilst dynamic cervical spine x-rays revealed no C1-C2 instability. These successfully, non-surgically treated cases suggest a role for external immobilization in the treatment of bony avulsion injuries of the transverse atlantal ligament in children.

53 Does Congenital Cervical Spinal Stenosis Contribute to Sports-Related Transient Neurologic Deficits in Children?

AUTHORS: Susan R. Durham, MD, John Boockvar, MD (Philadelphia, PA), Peter Sun, MD (Oakland, CA)

ABSTRACT:

Introduction: Congenital spinal stenosis has been postulated to contribute to transient neurologic deficits following cervical spinal cord injury in adult athletes. A Torg ratio (sagittal diameter of the spinal canal: mid-cervical sagittal vertebral body diameter)less than 0.8, which is indicative of significant spinal stenosis, has been reported in adult athletes presenting with sports-related transient neurologic deficits. While sports-related cervical spine injuries are common in children, it is unclear whether congenital spinal stenosis plays a role in the etiology of these injuries. We measured the Torg ratio in children presenting with transient neurologic deficits resulting from sports-related cervical spinal cord injuries to determine the presence of congenital spinal stenosis.

Methods: 13 children (9 male, 4 female) presented with transient neurologic deficits following a sports-related cervical spinal cord injury. Age ranged from 7 to 15 years (mean 11.5 +/- 2.7 years). The sports involved were football (n=4), wrestling (n=2), hockey (n=2) and soccer, gymnastics, baseball, kickball and pogosticking (n=1 each). Lateral cervical spine x-rays were used to determine the Torg ratio at the C4 level.

Results: The Torg ratio was 1.19 +/- 0.23 in these children (normal 1.0 or greater).

Conclusion: Using the Torg ratio as a measurement of congenital spinal stenosis, we did not find evidence of cervical spinal stenosis in a group of children presenting after sports-related cervical spinal cord injury. Return to play criteria, which in adults are largely based on the presence or absence of congenital spinal stenosis, need to be specifically defined for children.

54 Analysis of intracranial pressure during invasive monitoring of children with medically intractable seizures

AUTHORS: Karsten Fryburg, MD, Yong Park, MD (Kyungnbuk, South Korea), Jack Yu, MD, John Vender, MD (Martinez, GA), Mark Lee, MD, PhD (Augusta, GA)

ABSTRACT: Five patients between 8 and 14 years of age underwent invasive monitoring with subdural grid electrodes and an ICP-monitoring device. The ICP data were collected with a frequency of 1Hz and stored on a laptop computer. Parallel to the ICP-recording, EEG-data and video-tapes were recorded simultaneously and correlated with the ICP data. The patients showed different seizure types and origins, but have apparently common ICP-pattern before, during and after a seizure. Commonly a rapid ICP spike is seen at the onset of the majority of all seizures.These peaks lasts for 10 -20 seconds and are seen right at the onset of EEG-abnormalities or may precede them by 5-15 seconds. The ICP retuns to normal or slightly subnormal levels within 10-15 seconds, even though the seizure continues electrographically. The ICP slowly increases prior to a seizure over a period of 20-30 minutes to levels just slightly above the average at rest, while the post-ictal ICP course is slightly below that. The consistent pattern of the ICP-tracing at seizure time suggests a common trigger mechanism. The sharp rise and the rapid return of the ICP makes a vascular mechanism with a sudden, reversible increase in cerebral blood flow as underlying mechanism likely. Continuing studies with more physiologic parameters are required, as well as a more thorough mathematical analysis of the EEG and ICP curves. The application of non-linear algorhythms on EEG and ICP allows a more thorough analysis of the underlying causes and the establishment of equations describing exact causative relationships in a seizure.

55 Hemispherectomy in Older Children with Rassmussen's Disease

AUTHORS: Alan T. Villavicencio, MD, Michael Haglund, MD, PhD (Durham, NC), Daryl Lewis, MD, (Durham, NC), Rodney Radtke, MD (Durham, NC), Richard Morse, MD (Durham, NC), Ketan Bulsara, MD (Durham, NC), Timothy M. George, MD (Durham, NC)

ABSTRACT:

Introduction: Many surgeons to forego surgery and continue failed medical therapy in older children with Rassmussen's disease with the goal of sparing language and other neurologic function. The authors describe three older children with Rassmussen's disease and medically intractable seizures who underwent functional hemispherectomy.

Clinical Data: Patient ages were 10, 16 and 19 years old. All patients underwent the standard four phases of preoperative epilepsy evaluation. Two of three patients had biopsy-confirmed Rassmussen's prior to hemispherectomy.

Results: Follow-up ranged from 24 to 48 months (mean, 30 months). All three patients are seizure free and remain on decreased doses of antiepileptic medications. The two younger patients have made significant improvements in speech relative to their preoperative language abilities. The 19-year-old has been stable with respect to language, with no significant improvement. Following surgery, all three patients were left with slightly worsened contralateral hemiparesis, but had improved overall functional outcomes.

Conclusions: This data supports an aggressive surgical approach for seizure control in older children with Rassmussen's disease. Although focal deficits such as hemiparesis and visual field defects are seen, patients and families have improved overall outcomes. Hemispherectomy can be performed with good results in children well above the age of 10 years.

56 The Use of Intraoperative MRI for the Treatment of Pediatric Tumors

AUTHORS: Todd W. Vitaz, MD, Thomas Moriarty, MD, PhD (Louisville, KY), Stephen Hushek, PhD (Louisville, KY), Christopher B. Shields, MD (Louisville, KY)

ABSTRACT:

Introduction: The emergence of intraoperative MRI has opened new doors for the treatment of pediatric tumors. This technology will hopefully improve the surgeonÕs ability to obtain complete tumor resection with minimal damage to surrounding structures.

Method: We performed 17 procedures in 15 children in our intraoperative MRI system (GE Signa SP, open configuration). All procedures were performed within the magnet bore, which allows for either continuous real time or periodic imaging.

Results: Seven patients underwent surgical resection for intraparenchymal brain tumors (4 recurrent tumors). Two of these patients underwent frameless iMRI guided stereotactic biopsies for histological confirmation prior to their resections. Three patients underwent stereotactic catheter placement into tumor related cysts (2 cystic craniopharyngiomas, 1 hypothalamic hamartoma). Two patients underwent direct anterior micro-orbitotomy for resection of intraorbital masses, and another two patients underwent resection of posterior cervical masses. The final patient underwent iMRI guided open biopsy of a left perisylvian lesion. There were no infectious, hemorrhagic or neurological complications. Gross total tumor removal was obtained both by visual inspection and MRI imaging in 10 of the 11 patients undergoing resection.

Conclusions: Intraoperative MRI is an extremely useful tool for the treatment of pediatric tumors. Intraoperative imaging helps surgeons navigate through eloquent areas of the brain, orbit and spine and ensures the maximal possible tumor resection. It has also increased the armamentarium of minimally invasive neurosurgery in children. Hopefully this new technology will also prove effective in prolonging long term survival.

57 The Integration of Real-time Functional MRI in Pediatric Brain Tumor Resection

AUTHORS: John C. Wellons, III, MD, J. C. Leveque, BA (Durham, NC), Matt McGirt, BA (Durham, NC), Jeffrey Petrella, MD (Durham, NC), James Voyvodic, PhD (Durham, NC), Herbert Fuchs, MD, Michael Haglund, MD, Timothy George, MD (Durham, NC)

ABSTRACT:

Introduction: Real-time functional MR (fMRI) brain mapping provides a noninvasive means of determining cortical areas involved in motor or language skills. We evaluated this technique as a preoperative planning tool in pediatric neurosurgical patients scheduled to undergo craniotomy for brain tumor.

Methods: Ten subjects underwent fMR scanning on a GE 1.5T magnet while performing fine motor or language tasks. Intraoperative motor mapping took place during surgical intervention and pre-operative subdural grids were placed when appropriate for language mapping. Pre- and postoperative imaging and neurologic exam were examined.

Results: All examinations were well tolerated and completed in less than 35 minutes. Activation in the motor strips or language areas in the left frontal and temporal lobes was demonstrated. Post-operative imaging revealed satisfactory tumor resection. The incidence of postoperative neurologic deficit did not increase.

Conclusion: Real-time fMRI brain mapping is a valuable noninvasive aid in preoperative pediatric brain tumor resection planning by producing reliable activation maps utilizing easily and rapidly performed language and motor tasks. It has not, however, presently replaced the appropriate use of subdural grid placement or intraoperative cortical stimulation. The benefits as well as the drawbacks of this technology as it relates to the Duke experience will be discussed.

1 Experimental Cortical Dysplasia: Histological and Physiological Analysis

AUTHORS: Ethan A. Benardete, MD, PhD, Arnold R. Kriegstein, MD, PhD (New York, NY)

ABSTRACT:

Introduction: Cortical dysplasia is a frequently associated with medically refractory epilepsy. Because of this association, patients with this disorder often undergo surgical resection of dysplastic cortex. Understanding how cortical dysplasia causes epilepsy is therefore of interest to pediatric neurosurgeons. We have developed a model of cortical dysplasia in the rat and have studied the histology and physiology of dysplastic cortex.

Methods: Pregnant Sprague-Dawley rats were administered an intraperitoneal injection of carmustine (BCNU) on embryonic day 15. Rat pups were perfused and their brains processed for histology on postnatal days 0-70. Slices of adult dysplastic cortex were studied using field recording techniques to identify possible epileptiform activity. Furthermore, whole-cell patch clamping was used to study the physiological properties of individual neurons in dysplastic cortex.

Results: In utero exposure to carmustine produces rat pups with cortical dysplasia which has featues similar to that found in human dysplastic cortex. These features include subcortical and periventricular heterotopias, disruption of the normal cortical lamination, and hypertrophic neurons. Under conditions of partial GABA receptor blockade, slices of adult dysplastic cortex demonstrate hyperexcitability. Whole-cell recording suggests that some neurons in dysplastic cortex have reduced sensitivity to GABA.

Conclusion: We have developed a useful model of cortical dysplasia in order to understand the link between epilepsy and this disorder. Our data suggest that the developmental alterations in cortical dysplasia change the physiological properties of the neurons in dysplastic cortex making them less sensitive to inhibition and therefore more excitable.

2 Dural Closure in Pediatric Chiari Decompression: CSF Complications with Varied Closure Methods

AUTHORS: Mark G. Luciano, MD, PhD, Toru Fukuhara, MD, Samer Elbabaa, MD

ABSTRACT:

Introduction: Dural closure methods for Chiari decompression remain controversial. We review our experience with 33 children treated with various types of dural closure.

Methods: Thirty-three children with symptomatic Chiari type I malformation were treated over 5 years. All patients underwent a suboccipital decompression and a C1 laminectomy. The dura was not opened in 5 cases. Twenty-three patients underwent a watertight closure using cadaveric dura/fascia (n=9), Gore-Tex (n=8), occipital pericranial autograft (n=5) or Alloderm (n=1). In 5 cases the dura was left open, overlaying the defect with Duragen(bovine achilles tendon, n=3)or gelfoam only (n=2).

Results: Only one patient required a re-do decompression for persistent symptoms/syrinx and no patient required re-operation for complications. Post-operative complications included 2 CSF leaks(6%).The first leak occured after cadaveric dura closure and required a resuturing only. The second leak occured after an open dural defect with Duragen overlay and included pseudomeningocele and infection and required lumbar drainage and antibiotics. The overall rate of pseudomeningocele was 15% however these 5 CSF collections were transient with a median of 9 months for resolution and each occuured with a different closure material.

Conclusion: Although the patient number and complication rate is low our results favor a watertight closure. We did not identify a superior (or inferior)closure material.

3 Spinal Cord Syrinx Pulsations

AUTHORS: Bermans J. Iskandar, MD, Aclan Dogan, MD (Shreveport, LA), Peter Nguyen, MD (Madison, WI), Fred Lee, MD (Madison, WI)

ABSTRACT:

Introduction: Surgical drainage of a spinal cord syrinx does not always result in collapse of the cystic cavity, despite symptomatic improvement. In addition, collapse of a syrinx after surgery might take several months to occur, making the outcome of surgery difficult to predict. Such information agrees with the hypothesis that wall compliance plays a role in the radiographic appearance of a syrinx, regardless of the intracystic pressure.

Methods and Results: We present our intraoperative and postoperative observations in 6 young children with syringomyelia. With the use of spinal ultrasonography, we have observed that the early occurrence of syrinx wall pulsations after drainage was predictive of eventual symptomatic improvement and/or syrinx collapse. Furthermore, surgically obliterating the outflow of a syrinx in one patient seems to stop these pulsations.

Conclusion: The data suggest that the presence or absence of syrinx wall pulsations might be helpful in diagnosing inadequately drained syrinxes, and in predicting surgical outcome in cases in which the syrinx does not collapse. Such information might be of great value in treating children with complex neurological disorders that include syringomyelia, such as spina bifida.

4 Subarachnoid Hemorrhage Without Angiographic Vascular Anomaly in Pediatric Sickle Cell Disease

AUTHORS: Chad Prusmack, MD, Jonathan Jagid, MD (Miami, FL), Dorene Beguiristian, RN (Miami, FL), John Ragheb, MD (Miami, FL)

ABSTRACT: Children with sickle cell disease (hemoglobin SS) are known to be at increased risk for cerebrovascular accidents, including subarachnoid hemorrhage (SAH) and may harbor multiple aneurysms. The incidence of SAH without aneurysm or AVM in children with sickle cell disease (SCD) is unknown. A retrospective review of all children with SCD under the age of 18 admitted with SAH to a single hospital since 1985 identified six patients. One child had multiple aneurysms. The authors report the remaining five children in whom angiography did not reveal a vascular anomaly with a median follow up of 7.5 years. Review of the literature from 1957 to present reveals three additional cases. The safety and preparation for cerebral angiography in the sickle cell population are also discussed.

Five patients 8 to 15 years of age presented with typical symptoms and signs of SAH. Sixty percent had a history of and/or CT evidence of prior infarct. The median admission Hgb was 6.9. All patients with Hgb less than or equal to 7.1 (4/5) had negative CT scans and their SAH was diagnosed via lumbar puncture (LP). One patient, with a Hgb of 8.0 had SAH by CT scan. All patients had magnetic resonance angiography (MRA), of which four were normal and the fifth was inconclusive. Patients were treated with analgesics, oxygen and hydration. Three of five patients underwent single volume exchange transfusion on admission or prior to angiography such that median %Hgb S = 22.5 and median Hgb = 9.5. There were no complications during angiography. Follow up was 1 to 15 years with no recurrent SAH.

SAH in children with SCD is frequently not associated with an angiographically evident vascular anomaly. Previous CVA may be a risk factor and SAH is frequently not seen on CT when the admission hemoglobin is low (less than 7). MRA appears to be a useful screening tool. Angiography can be performed safely in patients with Hgb S less than 35% with or without transfusion.

5 Intracranial Complications of Frontal Sinusitis in Children: Pott's Puffy Tumor Revisited

AUTHORS: Nicholas C. Banbakidis, MD, Alan R. Cohen (Cleveland, OH)

ABSTRACT:

Objective: To describe the diagnosis and treatment of intracranial complications of frontal sinusitis (Pott's puffy tumor) in a series of pediatric patients at our institution. A rare entity, Pott's puffy tumor has been reported in only 13 cases in the antibiotic-era literature.

Methods: The hospital records and radiographic files at Rainbow Babies and Childrens Hospital over the previous 16 years were retrospectively reviewed in a search for patients with the diagnosis of Pott's Puffy tumor, defined as scalp swelling and associated intracranial infection.

Results: There were 6 male and 1 female patients. Ages ranged from 11 to 18 years (median 14.5 years). Intracranial infections consisted of epidural abscess in five patients, subdural empyema in four, and brain abscess in one. Intraoperative cultures grew anaerobic organisms in one patient, microaerophilic streptococcus in five patients, Klebsiella species in one patient, and Streptococcus pneumoniae in another. All patients presented with frontal scalp swelling, and other common symptoms included headache, fever, nasal drainage, and frontal sinus tenderness. Five patients were treated with antibiotics prior to their presentation. Four patients presented with neurologic decompensation characterized by varying degrees of hemiparesis, obtundation, pupillary dilatation, or aphasia. All patients underwent craniotomy and evacuation of the intracranial infection. Even severly impaired patients demonstrated full neurologic recovery.

Conclusion: Despite the widespread use of antibiotics, neurosurgical complications of sinusitis continue to occur. A high degree of suspicion, along with prompt neurosurgical intervention and the use of appropriate antibiotics can result in favorable outcomes in even the sickest patients.

6 Fibrous Tumors of the Calvarium: A Report of Two Cases and Review of the Literature

AUTHORS: Arthur J. DiPatri, Jr., MD, Eric Potts, MD (Baltimore, MD), Kymberly Gyure, MD (Baltimore, MD)

ABSTRACT: Pediatric neurosurgeons treat a variety of neoplasms of the scalp and skull. Fortunately, the great majority of calvarial masses in children are benign and excision of these lesions is usually performed to confirm the histological diagnosis. Infantile fibrosarcoma and infantile fibromatosis (desmoid tumor) are uncommon fibrous tumors that occur most frequently in the pediatric age group. The most common sites for these tumors are the extremities and the musculature of the head, neck and trunk. While previous reports have characterized lesions of the cranial base, we report two patients with lesions that primarily involved the calvarium. The first child was an eight month old boy who presented with a slowly enlarging, painless calvarial mass. Imaging demonstrated a lytic mass arising within the diploe of the calvarium. Following gross total resection, the pathology was consistent with an infantile fibrosarcoma. The second child was a three year old boy who presented with a slowly expanding, painless occipital mass. Imaging revealed a well-defined lytic lesion of the occipital bone and an overlying soft tissue mass. Following gross total resection, the pathology was consistent with infantile fibromatosis. Fibrous tumors are encountered infrequently by the neurosurgeon. Fibrosarcoma in infants and small children resemble adult forms but the clinical behavior is markedly different. Infantile fibromatosis shows a morphological range. Complete excision with ample margins is the preferred treatment for both tumors since there is a tendency for local recurrence. Recognition of these uncommon tumors will contribute to the neurosurgeon's management of calvarial neoplasms.

7 Apoptotis, Cell Proliferation and Drug Resistance Markers in Low Grade Astrocytomas

AUTHORS: Philipp R. Aldana, MD, Cheppail Ramachandran, PhD, Steve Melnick, MD, Andrew Jea, MD, P. Jhabvala, Anna Sotrel, MD, John Ragheb, MD, Glenn Morrison, MD (Miami, FL)

ABSTRACT:

Introduction: Low grade astrocytomas are known for their benign behavior, high cure rates and prolonged survival times after resection. Although histopathologically benign, some of these tumors can exhibit growth, recurrence, and even multicentricity. Furthermore, those with aggressive behaviour show varying responses to chemotherapy. To understand their behaviour, we prospectively studied fourteen tumors that exhibited a spectrum of proliferative behaviour prior to their resection.

Methods: In addition to histopathological analysis, all tumors were studied immunohistochemically using markers for cell proliferation (KI67 and PCNA) and apoptosis (Bax, Bcl-2, p53, p21). RT-PCR assays were used to detect resistance genes (MDR1, MRP, LRP and DRP) to chemotherapeutic drugs.

Results: Pathology included juvenile pilocytic astrocytomas (n=7), low grade fibrillary astrocytomas (n=4) and subependymal giant cell astrocytomas (n=2). There was one case of gliomatosis cerebri, where the individual neoplastic cells appear benign despite its infiltrative nature. Seven tumors showed evidence of growth, recurrence or multicentricity on preoperative imaging. The infiltrative fibrillar astrocytomas expressed Ki67, PCNA, p53, p21, Bax, MDR1 and LRP genes as compared to low levels of p21 expression in non-infiltrative low grade tumors. The newly cloned drug resistance marker, DRP, was co-expressed in 4/7 of pilocytic astrocytomas along with other markers (MDR1, MRP or LRP).

Conclusion: Apoptosis, cell proliferation, and drug resistance marker expression in low grade pediatric astrocytomas may be used to predict clinical behaviour. More extensive clinical studies are needed to better characterize the effects of these cellular processes on the overall course of these tumors.

8 Prognostic Heterogeneity of Intracranial Juvenile Pilocytic Astrocytomas

AUTHORS: Benoit J. M. Pirotte, MD, Alphonse Lubansu, MD, Philippe David, MD, Catherine Christophe, MD, Eric Sariban, MD, Maurice Lipszyk, MD, Jacques Brotchi, MD, PhD

ABSTRACT:

Introduction: Pilocytic astrocytomas (PAs) are histologically defined as grade 1 tumours and present as indolent or slowly growing neoplasms. Secondary malignancy/seeding have been exceptionally reported, mainly in adults. We have observed 4 juvenile PAs with aggressive evolution.

Methods: Since 1990, 29 children (12 girls/17 boys, mean age 7.7) were operated of intracranial PA: 16 infratentorial (9 cerebellar, 7 brainstem), 13 supratentorial (6 optochiasmatic, 7 thalamic/hemispheric). Treatment combined surgery (total removal (TR) 12, partial (PR) 9, biopsy 7) to chemotherapy/radiotherapy or radiosurgery. We retrospectively analysed symptoms, diagnostic presentation on magnetic resonance (MR) and postoperative outcome (follow-up/survival (months), tumour progression (TP), secondary lesion/malignancy).

Results: All PAs appeared well-delineated lesions on MR (gadolinium-enhancement in 26). Postoperative outcome was excellent (6-120 months) in 21children (11 without recurrence after TR, 10 without TP after PR/biopsy). Four children showed slow TP after PR/biopsy (12-37 months) and 2 developed secondary lesion 13 and 35 months after PR. Two others died from aggressive evolution: one presented an anaplastic recurrence and a secondary lesion 34 months after TR; another died from fast TP 6 months after PR despite reoperation confirming the remaining grade 1 histology. No correlation was found between histology and outcome.

Discussion and conclusion: Aggressive evolution of PAs could be more frequent than reported and is accurately predicted neither by current histological criteria, nor by radiological presentation/therapy applied. Prognostic parameters should be found to differentiate subtypes of PAs coexisting within the same histological and radiological appearance.

9 Epigenetic Regulation of Gene Expression in a Human Medulloblastoma Cell Line Using cDNA Arrays

AUTHORS: Alex Mohit, MD, PhD, Gregory Foltz, MD, Gerald Grant, MD, Lorne Walker, Peter Nelson, MD, Richard Ellenbogen, MD (Seattle, WA)

ABSTRACT:
The epigenetic phenomena of DNA methylation and histone deacetylation are widely considered to be major mechanisms of gene regulation in neoplastic progression. To analyze the role of these mechanisms in the regulation of gene expression in human medulloblastoma, TE671 an established medulloblastoma cell line was treated with 5-azadeoxycytidine and Trichostatin A (inhibitor of the histone deacetylase HDAC 1) in culture. Alterations in gene expression were studied using cDNA microarrays involving 7682 genes. Of these, 550 were differentially expressed (366 upregulated and 284 downregulated). We focused on upregulated genes as these were most likely to represent silenced genes in the neoplastic process. Among the differentially expressed genes, 3 classes of genes emerged which included those involved in neuronal differentiation, DNA repair and tumorigenicity. Genes involved in neuronal differentiation included BDNF (3.1 fold upregulated), neurofilament 66 (3 fold upregulated) and NSCL-1 (a bHLH protein expressed during cerebellar granule cell differentiation, 2 fold upregulated). Two DNA repair proteins, Rad50 and XRCC-1, were also upregulated. The final class of proteins identified included two complement proteins (clusterin and DAF) expressed in gliomas thought to be important in evading tumor surveillance. Epigenetic mechanisms for alteration of gene expression in cancer are poorly understood. Clinical manipulation of these phenomena may represent the most direct mechanism for altering gene expression through pharmacologic intervention.

10 Identification of Methylation Controlled Gene Expression in High Grade Gliomas Using cDNA Microarray Analysis

AUTHORS: Greg Foltz, MD, Alex Mohit, MD, PhD, Gerald Grant, MD, Lorne Walker, Michael Bobola, PhD, Peter S. Nelson, MD, Richard Ellenbogen, MD (Seattle, WA)

ABSTRACT:
Objective: Histone deacetylation and promoter region CpG island hypermethylation are important epigenetic regulators of tissue specific gene silencing during normal development. Recent evidence supports a role for gene silencing in the inactivation of tumor suppressor genes. Trichostatin A (TSA), a histone deacetylase inhibitor, and 5-azadeoxycytidine, a DNA methyltransferase inhibitor, exhibit potent differentiating effects on malignant astrocytes. We used cDNA microarray analysis to identify potential tumor suppressor genes aberrantly inactivated in glioblastoma.

Methods: Pediatric (UW467) and adult (U87, T89) glioblastoma cell lines were sequentially treated for 24 hours with 2 uM 5-AzaC and 0.5 uM TSA. Fluorescently labelled cDNA probes derived from treated cells and DMSO-treated controls were cohybridized to a customized cDNA microarray constructed from 7682 nonredundant sequence-verified ESTs. Differential gene expression profiles were generated with a clustering algorithm and confirmed by Northern blot analysis of statistically significant selected genes. Upstream promoter region CpG islands were identified by sequence analysis using Webgene.

Results: Genes upregulated at least two-fold included TIMP-1, lumican, galectin-7, zyxin, aquaporin, connective tissue growth factor (CTGF), t-PA, IGF1 receptor and bikunin. Of these, TIMP-1 and CTGF were previously reported as methylation controlled. Sequence analysis confirmed the presence of promoter region CpG islands in the remaining seven genes.

Conclusions: We have identified several previously unreported genes downregulated by promoter methylation and histone deacetylation in glioblastoma. Gene expression profiles resulting from inhibition of these epigenetic processes offers insight into aberrant transcriptional regulation during malignant astrocyte transformation and potential identification of tumor suppressor genes.

11 Large Cell/Anaplastic Transformation of Medulloblastomas and Medullomyoblastomas: Clinicopathologic and Genetic Evidence for Tumor Progressi

AUTHORS: Jeffrey R Leonard, MD, Dan X. Cai, MD, PhD (St. Louis, MO), Dennis J. Rivet, MD (St. Louis, MO), Bruce A. Kaufman, MD (St. Louis, MO), T. S. Park, MD (St. Louis, MO), Beth K. Levy (St. Louis, MO), Arie Perry, MD (St. Louis, MO)

ABSTRACT:
Objective: Medulloblastoma is the most common malignant CNS neoplasm in children. A distinct variant designated large cell/anaplastic medulloblastoma is characterized by frequent CSF dissemination at presentation and a more aggressive clinical course. We have examined the clinicopathologic and genetic features of seven such cases encountered at our institution.

Methods: Eighty cases of medulloblastomas were reviewed and seven were felt to fit the histologic and immunohistochemical criteria for large cell/anaplastic medulloblastoma. Fluorescent in situ hybridization on six of the seven cases was utilized to characterize the presence of isochromosome 17q, deletion of chromosome 22q (a deletion characteristically found in atypical teratoid/rhabdoid tumors), and c-myc amplification.

Results: Clinical histories revealed CSF dissemination in all cases and lymph node metastasis in one. In three of the cases, either desmoplastic or classic medulloblastoma were the underlying subtype, and in 2 cases (29%), the large cell/anaplastic tumor was found to arise from medullomyoblastoma. Isochromosome 17q was found in five of six cases. Evidence of chromosomal gains suggested aneuploidy in 3 tumors and amplification of c-myc was found in 3 tumors. No 22q deletions were encountered.

Conclusions: A high percentage of large cell/anaplastic medulloblastomas arise from typical medulloblastomas or medullomyoblastomas. As in conventional medulloblastomas, isochromosome 17q is a common early tumorigenic event. However, a significant percentage also have evidence of aneuploidy and/or amplification of c-myc. These findings suggest that large cell/anaplastic morphology reflects a stage of advanced tumor progression in medulloblastomas and medullomyoblastomas, not surprisingly associated with poor prognosis.

12 Synergistic Action of Genistein and Cisplatin on Growth Inhibition and Cytotoxicity of Human Medulloblastomas

AUTHORS: Sami Khoshyomn, MD, Paul L. Penar, MD (Burlington, VT), Sean M. Lew, MD (Burlington,VT), Steven L. Wald, MD (Cincinnati, OH), Gregory C. Manske, BS (Burlington, VT)

ABSTRACT: Recent experimental data have shown that soy isoflavones such as genistein significantly suppress the growth of most human malignancies. Here we examined whether genistein, at dietary plasma levels, in combination with cisplatin exhibited additive or synergistic inhibitory effects on the growth of medulloblastoma cells. Human medulloblastoma cell lines (HTB-186, MED-1 & CRL-8805) were treated with genistein at 6uM, the dietary plasma level in infants, combined with cisplatin (0-10uM). Monolayer cell proliferation and cytotoxicity were compared in control and drug-treated dishes. Apoptosis, using DNA-ladder assay and laser-scanning cytometry, was also investigated in all treated cells. Genistein (6uM) led to a 2.8-fold increase in monolayer growth inhibitory effect of cisplatin (0.05uM) in HTB-186 cells (P=4.5x10E-4 by one-tailed t test) and increased colonigenic survival inhibition 2.6-fold (P=1.5x10E-4). Genistein with cisplatin (0.5uM) led to a 1.7-fold increase in monolayer growth inhibition and 2.4-fold increase in colonigenic survival inhibition of MED-1 cells (P=8.3x10E-4 & P=1.1x10E-4 respectively). Genistein caused a 1.3-fold increase in antiproliferative effect of cisplatin (0.5uM) in CRL-8805 cells (P=3.1x10E-4) and enhanced the inhibition of colonigenic survival 2.0-fold (P=1.22x10E-5). These effects were primarily synergistic. These results indicate that genistein at dietary plasma levels significantly enhances the antiproliferative and cytotoxic action of cisplatin. The implication for treatment of medulloblastomas of early childhood may be a reduction in the chemotherapeutic dose recommendations of cisplatin and subsequently a decrease in risk of treatment sequelae.

13 Predictive Value of MR Spectroscopy in Pediatric Brain Tumors

AUTHORS: Amir Vokshoor, MD, Gregory W. Balturshot, MD (Columbus, OH), Jerome Rusin, MD (Columbus, OH), Edward J. Kosnik, MD (Columbus, OH)

ABSTRACT:

Introduction: MR Spectroscopy is a useful adjunct to current imaging modalities in diagnosing pediatric brain tumors. The maximum Choline (Cho)/N-acetylasparate (NAA) ratio has been reported to be predictive of prognosis. We correlate the histopathologic grade of biopsy proven tumor to the Cho/Naa ratio in twelve patients.

Methods: The single voxel MR Spectrocopy of twelve patients was obtained on a 1.5 Tesla GE scanner with a TR of 2000 and TE of 135. The ratio of metabolites Cho and NAA was analyzed. Patients were then divided into two groups based on their tumor grade.

Results: The mean Cho/NAA ratio was 7.8 in the high grade group with a range of 2.9-16.7. The mean Cho/NAA ratio was 1.64 in the low grade group with a range of 0.80-3.5. Four of five (80%) of the the high grade tumors had Cho/NAA ratios greater than 3.0. Only one of seven (14%) low grade tumors had a Cho/NAA ratio greater than 3.0.

Conclusion: The Cho/NAA ratio was found to be a good predictor of high grade pathology with a positive predictive value of 80%.

14 Intracranial Ependymomas in Children

AUTHORS: Benoit J. M. Pirotte, MD, Frank Van Calenbergh, MD (Leuven, Belgium), Christian Plets, MD (Leuven, Belgium), Jacques Brotchi, MD, PhD (Brussels, Belgium)

ABSTRACT:

Objectives: Childhood intracranial ependymoma is a relatively rare tumour. Some prognostic factors have been described, but treatment guidelines are not yet evidence-based, especially concerning adjuvant treatment (radiotherapy/chemotherapy) following complete resection. Because of the low incidence of ependymoma, we decided to analyse the series from two centers in our country.

Materials and Methods: Thirty-eight children (26 infratentorial, 12 supratentorial) were identified (1982-1999) and retrospectively analyzed using the same criteria, prognostic factors and outcome parameters, defined in consensus.

Results: In 28, complete resection was possible. Infratentorial tumours were predominantly grade 2 (17/26), supratentorial tumours grade 3 (8/12). There was no surgical mortality. Adjuvant therapy varied depending on age, chemotherapy study protocols, and local policy in the two centers. After average follow-up of 5 years, the outcome was: good in 22, moderate disability in 5, dead in 11. Of the alive patients, 23 were in complete remission, 3 in stable disease, one in progession. In 19 cases, tumour relapse occurred. Statistical analysis of prognostic factors (age, sex, tumour size and location, histological grade, degree of resection) will be presented.

Discussion and Conclusion: Evidence-based treatment guidelines are lacking for most rare tumours, like childhood ependymoma. Cooperation between centers for retrospective analysis is feasible and will lead to a prospective management protocol with specific recommendations concerning the place of shunt, the initial complete staging (pre-operative spinal magnetic resonance imaging and cerebro-spinal fluid analysis), the quality of the surgical resection, the efficiency of adjuvant therapy and the role of surgery at relapse.

15 Supratentorial Oligodendrogliomas in Children and Adolescents

AUTHORS: Daniel C. Bowers, MD, Linda Margraff (Dallas, TX), Deborah L. Doxey, PhD (Dallas, TX), Arlynn F. Mulne (Dallas, TX), Bradley Weprin, MD (Dallas, TX), Derek A. Bruce, MD (Dallas, TX)

ABSTRACT: Few reports describe supratentorial oligodendrogliomas in children and adolescents. Therefore, we reviewed our institution's experience with these tumors from 1985-2000. 23 patients were identified; this represented 2.7% of patients with CNS tumors. The median age was 7.0 years (range: 1-18 years) and male:female ratio was 1.3:1. 20 tumors were pure oligodendroglioma (WHO grade II) and 3 were anaplastic oligodendroglioma (WHO grade III). Tumor locations included the parietal (6 tumors), frontal (5), temporal lobe (4), frontal-parietal (2), parietal-temporal (2), and frontal-temporal lobes (2); one tumor each was located in the insula and the thalamus. Patients were followed for a median of 3 years (range: 0.5-10.7 years) after diagnosis. All pure oligodendrogliomas were primarily treated with only aggressive surgery. 9 of 20 pure oligodendrogliomas were completely resected; of these, only 1 has recurred. Of 11 pure oligodendrogliomas that were subtotally resected, 5 recurred at a median of 2.2 years (range: 0.4-5.5 years). None of these patients have died. All 3 patients with anaplastic oligodendroglioma were treated with adjuvant chemotherapy and have subsequently recurred or progressed (progression-free interval: 3 mo.-3.8 yr). Ki-67/MIB-1 immunohistochemistry will be performed on tumor specimens and included in the presentation. Oligodendrogliomas are uncommon tumors during childhood. In our series, there was a non-significant trend supporting correlation of complete resection of pure oligodendrogliomas with improved progression-free survival. We do not recommend adjuvant therapy for subtotally resected pure oligodendrogliomas. However, these patients need close follow-up for early detection of tumor recurrence.

16 Pediatric Dorsally Exophytic Brainstem Gliomas: Value of Aggressive Surgical Resection

AUTHORS: Renetta J. Osterdock, MD, Dwight E. Herron, MD (Memphis, TN), Richard L. Heideman, MD (Memphis, TN), Robert A. Sanford, MD (Memphis, TN), Larry E. Kun, MD (Memphis, TN)

ABSTRACT:

Introduction: Dorsally exophytic brainstem gliomas represent a subset of gliomas that carry a favorable prognosis after aggressive surgical resection.

Methods: Between January 1983 and December 1998, 20 children with dorsally exophytic brainstem glioma were treated at St. Jude Children's Research Center and LeBonheur Children's Medical Center. Ages were 1.5 to 16 years (median 4.8), 11 male, 9 female. Median follow up is 7.3 years. Pathology was juvenile pilocytic astrocytoma (15), fibrillary astrocytoma (4), and oligodendroglioma (1).

Results: Nine had gross total or near total resection and 11 had sub-total resection or biopsy. Seventeen were followed without postoperative intervention: 8 remained free of progression at 1.2 to 12 years, and 9 have required RT due to imaging evidence of disease progression. Three patients received immediate postoperative irradiation or chemotherapy. At 5 years, the freedom from progression rate is 46+/-13%, and the overall survival is 89+/-9%. Median time to progression was 7 months; all recurrences were local. The 5-year PFS for those with gross total or near total resection was 67+/-16% vs 27+/-16% for sub-total resection. Freedom from progression following irradiation was 75% at 5 years. Two deaths occurred: one with secondary leukemia, and one after multiple recurrences of an oligodendroglioma.

Conclusions: Dorsally exophytic brainstem gliomas have an excellent prognosis in contradistinction to diffuse intrinsic brain stem tumors. Aggressive surgical resection gives a 57% 5-year progression free survival, and the strategy of delayed irradiation remains reasonable with excellent secondary disease control to date.

17 Interest of Combining Positron Emission Tomography and Magnetic Resonance Imaging in the Planning of Stereotactic Brain Biopsies in Children: Preliminary Experience in 9 Cases

AUTHORS: Benoit J. M. Pirotte, MD, Sacha Salzberg, MD (Brussels, Belgium), Patrick Van Bogaert, MD, PhD (Brussels, Belgium), Serge Goldman, MD, PhD (Brussels, Belgium), Delphine Lejeune, MD (Brussels, Belgium), Marc Levivier, MD, PhD (Brussels, Belgium), Jacques Brotchi, MD, PhD (Brussels, Belgium)

ABSTRACT:

Objectives: Because brain tumours are histologically heterogeneous, stereotactic brain biopsies (SBB) may lead to inaccurate diagnosis/grading. We developed a technique allowing routine integration of positron emission tomography (PET) data into the planning of SBB (Neurosurgery 31;792-797,1992). Combination of PET and magnetic resonance (MR) in the planning of SBB increased the technique's diagnostic yield in adults (J Neurosurg 82;445-452,1995). We report our preliminary experience applied to children.

Materials and Methods: Since 1994, 9 children (5M/4F, aged 2-14y) with infiltrative, ill-defined brain lesions (2 brainstem, 4 supratentorial-hemispheric, 2 pineal, 1 suprachiasmatic) were biopsied using combination of stereotactic PET (Fluorodeoxyglucose in 4; Fluorodeoxyglucose and Methionine in 3; Methionine in 2) and MR. This technique was analysed in view of routine prospective application.

Results: This technique allowed to: -obtain histological diagnosis in all patients; -reduce the number of trajectories (2 brainstem and 2 pineal tumours); -select targets in hypermetabolic areas (4 supratentorial-hemispheric tumours), allowing subsequently 2 PET-guided resections; -exclude malignancy by guiding biopsy to hypermetabolic area in a suprachiasmatic lesion.

Discussion and conclusion: This preliminary series shows that this technique: -is applicable to children; -renders a high diagnostic yield in infiltrative, ill-defined tumours; -allows to reduce the number of trajectories in high-risk regions.

18 Enhanced Preoperative Planning Using Composite Digital Holograms Coregistered with Frameless Stereotaxy for Pediatric Low Grade Glioma Surgery

AUTHORS: John J. Collins, MD†, Raymond A. Schulz, MSc (San Francisco, CA), Michael N. Dalton, BSci (Provo, UT), Stephen J. Hart, BSci (Provo, UT)

ABSTRACT: Holograms from digital source images translucently reveal the volumetric shape of intrinsic brain tumors completely oriented in space relative to surrounding structures. Frameless stereotaxy, however, can show the full grey scale of each tomographic slice in three orthogonal planes. In co-registry these two modalities together provide a markedly enhanced 3D surgical orientation.

To take advantage of these capabilities during pre-operative planning for surgery on a thirteen-year-old boy with a low-grade glioma inferior and medial in the non-dominant temporal lobe, we achieved the following innovations.

Stick-on fiducial makers were applied to the patient's scalp. He then underwent MRI, MRA and CT, which revealed tumor and various aspects of intracranial anatomy. The holography production process converted these sequences onto film, which when overlaid on a special view box projected a single composite hologram of all the source image sequences with the scalp fiducial markers evident. A new technique allowed registry of these holographic fiducial markers to the fiducials in the source data sequences on the frameless stereotaxy system. Pre-operative planning then involved moving the stereotactic probe through the composite hologram as a virtual pre-enactment of the planned procedure.

Composite holograms co-register to frameless stereotaxy with standard deviations of error less than 2mm. Co-navigation with frameless stereotaxy through a composite hologram provide a detailed assessment of tumor shape and volumetric orientation together with precise boundary and edge delineation. The comprehensive image information afforded by this technique helped to assure safe, radiographically complete tumor resection in this case via an anterior skull-based neurosurgical approach.

19 Failure of Autogenous Cranioplasty Following Decompressive Craniectomy in Children

AUTHORS: Gerald A. Grant, MD, Matthew Jolley, BS, Gregory D. Foltz, MD (Seattle, WA), Joseph R. Gruss, MD (Seattle, WA), Richard G. Ellenbogen, MD (Seattle, WA), Theodore S. Roberts, MD (Seattle, WA), H. Richard Winn, MD (Seattle, WA), John D. Loeser, MD (Seattle, WA)

ABSTRACT:

Objective: We routinely perform primary autogenous cranioplasty to repair skull defects following decompressive craniectomy. High rates of subsequent bone resorption in children prompted this study.

Methods: An institutional review identified 40 children (32 male) aged 4 months to 19 years who underwent autogenous cranioplasty after decompressive craniectomy (17 left; 18 right; 5 bifrontal) for varied causes {trauma (33), infection (1), tumor (1), or spontaneous ICH (5)} from October 1987 to March 2000 (average follow up 4.8 years; range 6 months-13 years). The skull defect was predominantly frontal (55%) and/or parietal (43%). The defect surface area ranged from 14 to 147 cm2 (average 99 cm2). In all cases, the bone was cryopreserved at the time of decompression.

Results: 22 children (55%) suffered symptomatic bone resorption which required reoperation in 95% of cases. The incidence of bone resorption significantly correlated with an increased skull defect area (p less than 0.05). No significant correlation was found with age, side or location of the skull defect, number of fractured bone fragments, presence of a shunt, cause for decompressive craniectomy,

method of duroplasty, or interval between the decompressive craniectomy and cranioplasty (average 4.8 months). Reoperation to repair the resorbed autogenous cranioplasty was performed from 2 months to 76 months.

Conclusions: The use of autogenous bone to reconstruct pediatric skull defects following decompressive craniectomy is associated with a high incidence of bone resorption. The use of autogenous bone should be reevaluated in light of the excessive need for reoperation in the pediatric population.

20 Craniosynostosis in the Perinatal Rat Using Methyl-2-Cyanoacrylate: A Neuroanatomic Study

AUTHORS: Khalid A. Sethi, MD, Walter Low, PhD (Minneapolis, MN), Cornelius H. Lam, MD (Minneapolis, MN)

ABSTRACT:

Introduction: The effects of premature sutural synostosis on the developing brain remain unknown. A model of craniosynostosis in the perinatal rat was used to investigate the morpohological and cytoarchitectural changes in the maturing brain.

Methods: A total of 56 peri-natal rats, eight in each subgroup were utilized. Methyl-2-cyanoacrylate was applied across the saggital, coronal and lambdoidal sutures in the rats at post-natal days 0,3, and 7 under hypothermic arrest. Sham rats underwent similar hypothermic arrest and application of methyl-2-cyanoacrylate, but at a site different from the sutural lines. Age matched rats who underwent no procedures were included as normal controls. Serial gross measurements were taken to chart calvarial growth and computerized tomography utilized to calculate mean calvarial volumes. At 30 days post natal all rats were sacrificed, the brains fixed insitu, and a detailed morphological and cytoarchitectural analysis undertaken.

Results: There was no statistical difference in any of the analysis between sham rats and normal age-matched controls. Calvarial growth rates (ANOVA, p less than 0.05) mean brain weights, (t-test, p less than 0.01) anterior-posterior, and lateral diameter measurements (t-test, p less than 0.01) were different for all synostotic rats versus shams. On cytoarchitectural surveys there were noted differences in radial-glial lamination patterns, focal areas of nodular heterotopia and differences in cell density at the pyramidal cell layer. (t-tail, p less than 0.01)

Conclusion: Early pan-calvarial sutural synostosis in the peri-natal rat using methyl-2-cyanoacrylate is associated with morphometric and cytoarchitectural changes in the developing brain.

21 Cranioplasty in the Young Child: Successful Use of Rib

AUTHORS: Derek A. Taggard, MD, Arnold H. Menezes, MD (Iowa City, IA)

ABSTRACT: Successful closure of a large cranial defect in the young child requires the cranioplasty material adapt and grow with the skull, protect the cranial contents from external forces, be strong and pliable and available in sufficient quantities. This is best achieved with autologous bone that can withstand contour and resist resorption, with minimal morbidity at the donor site. Iliac crest, calvarium and fibula do not fulfill the requirements. The authors have utilized autologous rib grafts for spinal reconstruction and report their experience with pediatric cranioplasty.

Between 1988 and 2000 11 children, age 11 months to 11 years, underwent rib graft cranioplasty. Mean follow-up from surgery is 27 months, with 10 subjects followed a minimum of 12 months. Etiologies of the cranial defects were: post-traumatic (5), growing skull fracture (2), previous encephalocele closure (2), reconstruction following tumor resection (1), and infected bone flap removal (1). The mean defect size was 41 cm2 (8 to 144 cm2) and the number of ribs harvested was 1.75 (1 to 3).

No donor or recipient site complications were noted. Ribs reformed in 3 children who had surgery before 4 years of age. Cranial contour was immediate and an excellent cosmetic result achieved in 11 patients. The largest defect occurred in a 5 year-old and required staged reconstruction. Rib grafts are an excellent bone source that fulfill the requirements for cranioplasty in a young child. They act as a contouring substrate upon which osteoinductive and osteoconductive bone extenders can enhance the effectiveness of the cranioplasty procedure.

22 The Surgical Correction of Metopic Synostosis

AUTHORS: Mark D. Krieger, MD, J. Gordon McComb, MD (Los Angeles, CA), Michael L. Levy, MD (Los Angeles, CA)

ABSTRACT: Premature closure of the metopic suture results in calvarial deformation that can vary from mild to severe. Mild forms are marked by prominent ridging of the metopic suture; more severe forms result in a marked narrowing of the frontal and temporal regions that in turn affect the supraorbital rims and produce hypotelorism. We retrospectively reviewed 39 cases of metopic synostosis treated over a 10 year period. This series included 26 males and 13 females. The average age at referral was 5 months, with surgery performed at an average of 7.5 months. 15 infants had other congenital anomalies, with 8 having synostoses of other sutures. Follow-up ranged from 1 month to 5 years, with an average of 19 months. Care was taken to tailor the operative procedure to the nature of the deformity. In 3 mild cases, burring of the metopic ridge was performed, with excellent cosmetic results in all cases. The other 36 patients had significant deformity of the supraorbital ridges and temporal regions, with varying degrees of hypotelorism. In these cases, the patients underwent craniofacial reconstruction to normalize their appearance. In addition, the lateral aspect of the sphenoid ridges, including the orbital roof and lateral orbital wall to the infraorbital fissure, was removed to free the cranial base. Results were considered good to excellent in all except 3 cases. These cases had recurrence of a prominent metopic ridge; two required a second operation after 6 months for burring of this ridge, whereas the third was treated conservatively with an orthotic head band. At follow-up, 6 (15%) of the patients were classified with developmental delay. A flexible approach to this problem can yield an immediate correction of this deformity with minimal morbidity.

23 Pluronic Surfactant Polymer as a New Bone Hemostatic Agent in Children That Does Not Impair Osteogenesis

AUTHORS: Michael Y. Wang, MD, John Armstrong, PhD, J. Gordon McComb, MD (Los Angeles, CA), Michael L. Levy, MD (Los Angeles, CA)

ABSTRACT: Intraoperative control of bone bleeding in can be accomplished with Bonewax. However, this inhibits osteogenesis locally and should be avoided in settings where fusion is critical. A polymerized surfactant with physical characteristics similar to beeswax was developed to overcome this problem.

A femur bone defect and a femur gap nonunion model were used to assess bone fusion. Twenty-six Sprague-Dawley rats underwent drilling of a surgical defect in the femur. A titanium plate was used to maintain long bone alignment. In the gap model no plating was used. Bonewax¨, surfactant, or no implant were inserted into the defect. Animals were sacrificed at 7, 21, and 42 days and femurs were removed for evaluation.

In the defect model, radiographs at 42 days showed no difference between polymer and controls. Bonewax¨ in this model showed impaired bone growth at the defect site. However, cartillaginous growth was seen in the site of Bonewax¨ implantation.

In the nonunion model no fusions occurred in any group as expected. H & E staining showed development of an osseous callous at the gap site in controls and those with polymer. Rats implanted with Bonewax¨ showed no osseous growth.

Surfactant polymer has physical hemostatic characteristics similar to Bonewax™ but does not inhibit bone growth. This may serve as an effective substitute for Bonewax™ in children to treat bone bleeding in sites where fusion is critical.

24 Stress-Sensitive Calcium-Channels in Developing Rat Cranial Sutures

AUTHORS: Karsten Fryburg, MD, Jack Yu, MD, James Borke, PhD, Ann-Marie Flannery, MD (Augusta, GA)

ABSTRACT: Our current assumption is that cranial morphogenesis is a complex adaptive process with intrinsic genetic programs dictating the "rules" how to react to physical stimuli. One question is how the fine-tuning of the cranial morphogenesis is caused by changes in the environment of the developing skull. The content of the neurocranium is incompressible and wall tension would increase during the development of the nervous system unless the neurocranium expands. This series of experiments tests the hypothesis that mechanotransduction occurs within the sutural cells and addresses specifically the nature of tension-induced calcium flux.

Methods: 3 pairs of coronal sutures from 1 week old rats were incubated with a fluorescent calcium-sensitive indicator. After dye loading, the sutures were mounted in a fluorescent spectrophotometer to undergo cyclic strains by 0.59 N of isotonic tensile force. The intracellular calcium concentration was obtained from the emission ratio at340/380nm. Other variables tested were external calcium concentration, endoplasmic calcium stores, and plasma membrane calcium channels.

Results: 1. Changes in wall tension lead to immediate and reversible rise in intracellular calcium ion concentration as reflected by increase of the emission ratio from 1.23 +/- 0.0028 to 1.26 +/- 0.0054 (p =0.002) 2. These changes are dependent on a pre-existing calcium-ion gradient between the cytosol, extracellular compartment, and endoplasmic reticulum. 3. These changes were not abolished by the traditional calcium channel-blocker Diltiazem or by inhibition of the endoplasmic Ca/ATPase.

Conclusion: Immature cranial sutures respond rapidly to extrinsic tension by intracellular calcium increase. This increase is reversible, robust, and depends on an existing calcium ion gradient.

25 The Safety of Tapping a Shunt

AUTHORS: Mark D. Krieger, MD, J. Gordon McComb, MD (Los Angeles, CA), Michael L. Levy, MD (Los Angeles, CA)

ABSTRACT: Percutaneously tapping a shunt may provide important diagnostic information regarding intracranial pressure, the proper functioning of a CSF diversion system, and properties of the CSF. However, concern exists that shunt tapping is accompanied by a real risk of shunt infection. To assess this risk, a retrospective review was conducted of our management of shunts in a pediatric population during the calendar year 1999. During this year, 331 shunt-related operative procedures were performed: 84 new placements and 247 revisions. 386 shunt taps were performed on 249 patients using a standard technique. (Alcohol and betadine swabs were used to prepare the unshaven shunt reservoir. A 25-gauge butterfly needle was used to enter the reservoir. Cell count, gram stain, and cultures were performed on all CSF obtained.) 17 shunt infections were seen over this study period, documented by CSF pleiocytosis and positive culture results. However, in no case was the CSF sterile at time of tapping and then subsequently infected; thus, no infections were attributable to the shunt tap itself. An additional corroborating data set is obtained from ventricular catheter reservoirs placed in 9 neonatal patients to treat hydrocephalus subsequent to germinal matrix hemorrhages over the same year. These reservoirs were tapped on average of 19 times each (range 4-38). Using the aforementioned criteria, no infections were seen during this year attributable to these 171 reservoir taps. We thus conclude that the risk of infecting a shunt (or a reservoir) by tapping is exceedingly low if consistent meticulous technique is employed.

26 A Proximal Ventricular Catheter Occlusion Model and Comparison of Catheter Coring Techniques

AUTHORS: Mark S. Gerber, MD, Aaron Kamauu (Provo, UT) Kim H. Manwaring, MD (Phoenix, AZ)

ABSTRACT:

Introduction: Ventriculoperitoneal (VP) shunts often fail when the proximal catheter becomes occluded with choroid plexus. A model was therefore developed to simulate ventricular catheter occlusion and re-establishment of patency without catheter replacement.

Methods: Proximal occlusion was simulated by dipping the catheter drainage holes in egg whites and microwaving the catheter briefly. Catheter obstruction was confirmed using an intraluminal pressure microsensor (Codman Wire). A Codman Microendoscopic Electrode (ME2) was used to deliver monopolar desiccating current to the tissue insinuated through the proximal catheter inlet holes. Once the holes were reopened, the microsensor was used to verify re-establishment of pulsatile flow of cerebrospinal fluid. This was compared to the efficacy of conventional R.F. power application to a steel stylet.

Results: The ME2 opened each clogged catheter in a series of 10 experiments. Only 15 watts of power was required to open a clogged catheter compared to more than 25 watts with the steel stylet technique. In three of ten trials, the steel stylet was unable to reopen the catheter. A risk of steel stylet protrusion through the catheter inlet holes was also observed.

Conclusion: Compared to a monopolar coagulating current applied with a steel stylet, the ME2 technique requires less wattage. The catheter occlusion model can also be used to compare the efficacy of other catheter-coring protocols. Use of the ME2 as described may offer safe and effective revision of obstructed shunts without replacement in both the operating room and outpatient settings.

27 Duration of Antibiotic Therapy for the Treatment of Shunt Infections—A Retrospective Review

AUTHORS: William E. Whitehead, MD, MPH, John R. W. Kestle, MD (Salt Lake City, UT)

ABSTRACT:

Introduction: Despite the prevalence of CSF shunt infections, it is our impression that the most effective management strategy for infected shunts has not been determined. In addition, we have found through survey data that the duration of antibiotic therapy for shunt infections is highly variable among pediatric neurosurgeons. Currently, there are few reports in the literature which correlate duration of antibiotic therapy with treatment outcome. The purpose of this paper is to present the outcome data from all shunt infections treated at a pediatric hospital from January 1, 1999, to December 31,1999, with respect to the duration of IV antibiotic therapy.

Methods: A retrospective review was done of consecutive patients treated for CSF shunt infection at Primary Children's Medical Center in Salt Lake City, Utah (a tertiary care children's hospital).

Results: Twenty-seven cases were reviewed. Most patients were treated with removal of the shunt, placement of an EVD, and a course of IV antibiotics. The duration of IV antibiotic therapy after CSF cultures were sterile for coagulase-negative staphlococcus, S. aureus, and GNR infections was 6-31 days (n=15), 10-16 days (n=5), and 14-20 days (n=7), respectively. There were no recurrent infections.

Conclusions: Our practice of treating shunt infections is very effective but requires prolonged hospitalization. Since there were no recurrent infections despite variability in the number of days of treatment, these data raise the possibility that the duration of antibiotic therapy could be shortened without compromising efficacy of treatment.

28 The Surgical Management of Multiloculated Hydrocephalus

AUTHORS: Mark D. Krieger, MD, J. Gordon McComb, MD (Los Angeles, CA), Michael L. Levy, MD (Los Angeles, CA)

ABSTRACT: Multiloculated hydrocephalus, most commonly seen as a sequella of neonatal intraventricular hemorrhage or meningitis, remains a difficult neurosurgical problem. Various management strategies have been advocated, including multiple shunting procedures, endoscopic fenestration with or without catheter placement, and craniotomy for fenestration. The authors review their 10-year experience with 39 cases of multiloculated hydrocephalus. Etiological factors cited included meningitis (19 cases - gram-negative organisms identified in 12 of these), intraventricular hemorrhage (11 cases) and unknown (9 cases). The series included 24 males and 15 females, and ranged in age at the time of the definitive procedure from 2 weeks to 13 years (median age=2.5 years). Each patient underwent a procedure for fenestration of septations, either via an open small craniotomy (27 patients) or endoscopically (12 patients). Of the 27 patients who underwent craniotomy, 15 had concomitant placement or revision of a ventricular shunt; 7 of the remainder required a subsequent shunting procedure. Eight of the endoscopically fenestrated patients had concomitant shunt placement; 2 of the remainder required a subsequent shunting procedure. Operative morbidity was minimal with all of these procedures; however, very few of these patients (9) had normal neurological exams on long-term follow-up, likely a result of the primary pathological process. Importantly, these patients had an average of 2.5 procedures per year prior to the fenestration procedure, but only 0.5 procedures in the subsequent year. These results indicate that ventricular fenestration, either endoscopically or open, with placement of a ventricular shunt, is a safe an effective means of managing multiloculated hydrocephalus.

29 Aqueductal Stenosis: Endoscopic Aqueductoplasty and Aqueductal Stenting as an Alternative to Third Ventriculostomy

AUTHORS: Aaron Mohanty, M Ch, Thimappa Hegde (Bangalore, India), M. K. Vasudev (Bangalore, India), S. Sampath (Bangalore, India), S. Radhesh (Bangalore, India).

ABSTRACT: In Aqueductal stenosis (AS), Endoscopic third ventriculostomy (ETV) is currently considered as the procedure of choice, where as in suitable cases, Aqueductoplasty (AP) and Aqueductal stenting (AST) are fast emerging as alternatives. The authors summarize their preliminary experience of the three procedures performed at National Institute Of Mental Health and Neurosciences, Bangalore, India.

From July 1999 - May 2000, 15 children were treated by endoscopic procedures for hydrocephalus resulting from AS. All patients had undergone MRI scans preoperatively. Basing on the MRI findings the aqueductal stenosis was classified into : Long segment (LSAS), Short segment (SSAS) , Multi segment (MSAS) and Aqueductal web(AW). Patients of LSAS and MSAS were considered for ETV where as patients with SSAS or AW were offered AP or AST. The breakup of the initial procedure is as follows : ETV: 8, ETV + AP: 2, AST: 3, AP: 2.

Results: During the follow up (3-12 months), of the 8 who had undergone ETV, 4 failed requiring subsequent shunt insertion. Of the 3 with AST, the stent was malpositioned in one requiring removal. One patient with AST had transient upward gaze paresis. There was no failure in the 7 patients who underwent AP or continued with AST.

Conclusion: Though ETV is well established as the procedure of choice in patients with AS, AP and AST are the available alternatives to be considered in suitable cases.

30 Laparoscopic Distal Catheter Evaluation to Rule Out Ventriculoperitoneal Shunt Failure and Infections

AUTHORS: Nicholas Theodore, MD, Howard Riina, MD (Phoenix, AZ), Donna Wallace, RN, MS, CPNP (Phoenix, AZ), Geoffrey Zubay, MD (Phoenix, AZ), Raymond Shamos, MD (Dept. of Surgery) (Phoenix, AZ), Harold L. Rekate, MD (Phoenix, AZ)

ABSTRACT:

Introduction: The diagnosis of distal shunt failures and infections can be problematic and often involves externalization or removal of indwelling hardware. We present a new method of diagnosing and managing suspected distal shunt failures and infections.

Methods: Six patients (average age 38.5 years, range, 21-58) with ventriculoperitoneal (VP) shunts developed acute abdominal pain; one developed a low-grade fever. All underwent laparoscopic exploration by an experienced general surgeon and were treated during the same procedure. The distal peritoneal catheter tip was biopsied for gram stain, culture, and sensitivity.

Results: Five patients (83%) underwent adhesiolysis to remove active or potential sites for shunt malfunctioning. In one patient each with right and left upper quadrant pain, the shunt catheter was repositioned from adhesions around the liver and spleen, respectively. In one patient the catheter was removed from an area of pseudocyst. In one patient with endometriosis the catheter was repositioned from an entrapped area of adhesions and shortened. The results of biopsy were uniformly negative.

Conclusions: Laparoscopic evaluation of distal VP shunt catheters is an innovative and effective technique for diagnosing and treating distal shunt failure. It eliminates the need to externalize or remove indwelling hardware and offers a minimally invasive method to rule out the presence of distal shunt infections. This technique has the potential to become standard practice in the management of patients with abdominal pain and VP shunts.

31 The Codman Hakim Programmable Valve as a Replacement Valve in Complicated Hydrocephalus

AUTHORS: Rachana Tyagi, MD, Karin S. Bierbrauer, MD (Philadelphia, PA)

ABSTRACT:

Objective: We examined the performance of Codman Hakim programmable valves as a replacement valve in patients with previous pressure or flow-regulated valves.

Methods: The authors performed a review of five patients with shunt revisions using programmable versus other valves. Hydrocephalus was caused by: slit ventricle syndrome due to overdrainage in idiopathic congenital hydrocephalus (2 pts) or post-occipital encephalocele repair (1 pt), a Chiari malformation (1 pt) and a tectal glioma (1 pt). Analysis was performed using the chi-squared test of differences between the groups.

Results: Seventy-four revisions with 9 simple pressure-regulated, 6 flow-regulated and 15 programmable valves were performed. Shunt revisions were performed an average of 2.33, 1.33 and 3 times respectively for each valve type. Significantly, average shunt survival was 25.7 days, 16 days, and 57.4 days, whereas the average valve survival was 66.9, 24.5, and 133.8 days. One programmable valve was replaced when it became difficult to reprogram. Patients needed reprogramming 250 times (range 1-182). Infection rates for each valve type were 11%, 20%, and 33%.

Conclusions: The Codman Hakim programmable valve appears to be useful in patients with complicated hydrocephalus. Use of programmable valves extended the time to first revision, as well as the life-span of the valve. The benefits of using the programmable valve must be considered against the inconvenience of frequent reprogramming to the family and physician. Further clarification regarding the appropriate population for use of the programmable valve is needed.

32 Venous Overdrainage in Slit Ventricle Syndrome

AUTHORS: Sandeep Sood, MD, Kaveh Barami, MD, PhD (Detroit, MI), Alexa I. Canady, MD (Detroit, MI), Steven D. Ham, D.O. (Detroit, MI)

ABSTRACT: Mechanisms responsible for maintenance of ICP in upright position remain controversial. Post lumbar puncture headaches and CSF hypotension attributed to continued leakage at the site of dural puncture. Likewise the postural intracranial hypotension in shunted patients is believed to result from siphoning of CSF. These patients sometimes respond to use of abdominal binders or build up of vascular volume none of which is likely to restore CSF volume rapidly. Contrarily the abdominal binder increases ICP and should promote increased loss of CSF from the site of LP and simultaneous increase in abdominal and ICP should not alter the drainage through the shunt Our hypothesis is that the rapid drop in ICP occurs from fluid shifts occurring in non-CSF compartment that is exaggerated in presence of drainage from the shunt or following withdrawal of CSF after lumbar puncture. We studied intracranial pressure changes in 15 patients who had slit like ventricles and were externalized for treatment of shunt infection. The intracranial CSF volume was estimated on CT scans. Pressure volume index was estimated using bolus injection technique and the fluid shifts to explain the observed pressure drop in upright position was calculated using the 'negatively symmetric non-linear model' proposed by Drake et al.The average intracranial CSF volume in these patients was 8.8 cc (SD,+6.3), the estimated PVI, 41 cc and mean drop in ICP on upright posture, 152 mm water. The calculated fluid shift exceeded the intracranial volume of CSF and was estimated to be 20.9 cc. Based on these results, we feel that on upright posture the critical balance that keeps the bridging veins collapsed from the 'starling resistor' effect of the subarachnoid CSF pressure is disturbed by small amount of fluid displacement that occurs through the shunt or from LP. This displacement in it-self may not cause significant drop in ICP, the resultant opening of the bridging veins causes venous siphoning and consequent rapid fall in the ICP. Measures to increase venous pressure by use of abdominal binders or increasing vascular volume are therefore effective in counteracting rapid fall in ICP observed in this group of patients.

33 In-Vitro Evaluation and Theoretical Designs of VP Shunts Using Experimental Test-Bench and Computer-Simulation

AUTHORS: Martin Morris, PhD, Julian Lin, MD (East Peoria, IL), Robert Hurt, PhD (Houston, TX), William Olivero, MD (Peoria, IL)

ABSTRACT: The objective of the study is to provide useful information about the fluid mechanics of shunt systems by 1)testing and analyzing existing proximal/distal catheters and valves using a test-bench and 2)calculating flow-pressure relationships given the entrance and exit conditions using computer software. Differential-pressure and siphon-preventing valves with different settings and sizes were tested. The software Engineering Equation Solver (EES) was used to 1) analyze experimental data from the test-bench to obtain equations describing the relationship between flow rate and resistance and 2) calculate flow rates given different variables. Results showed that our test-bench was valid with repeatable data gathered within 5% while the experimental versus theoretical comparison varied within 7%. In the upright position, shunt with differential-pressure valves overdrained and acted like switches. Siphon-preventing valves fared better in terms of overdrainage. Other factors such as the size and setting of the valves played a minor role although larger size and higher pressure setting did provide lower flow rates. Identical valves deviated less than 9%. Uncertainty analysis of the results obtained from the EES agreed within 1%. Theoretical designs from EES showed that the flow rate could be reduced by more than 100% if the diameter of the distal catheter is halved. Increasing the length of the distal catheters also reduced the flow rate. In conclusion, each components of the shunt is important in determining the fluid dynamics of the system. More emphasis should be placed on proximal and distal catheters in future designs.

34 Outcome of Scoliosis After Primary Spinal Cord Untethering

AUTHORS: Michael H. Handler, MD, FACS, FAAP, Brian Callahan, BA (Denver, CO)

ABSTRACT: Scoliosis has been attributed to spinal cord tethering in patients who had undergone closure of a meningomyelocele, and has been shown to stabilize or improve in these patients after an untethering operation. We reviewed records of 20 patients with a variety of primary tethering lesions who had scoliosis among their presenting findings to assess the impact of untethering on scoliosis. Three had untethering at the time of fusion, and so were excluded. Two more were lost to long term follow-up. Of the remaining 15, three patients required fusions at three months, at 2 years, and 6 years post-untethering. After untethering, one patient had significant improvement in a severe curve, but then had two more untethering operations before finally progressing to need a fusion. The remaining eleven patients have avoided fusion. Three had significant improvement in their curves, four stabilized, and four had mild progression that did not necessitate operation. It appears that aggressive work-up of scoliosis with imaging may identify patients with a tethering lesion, and untethering may improve the course of scoliosis when curves have not yet progressed to the point of needing a fusion.

35 Simultaneous Orthopedic and Neurosurgical Treatment of Cerebral Palsy Spasticity

AUTHORS: Samer K. Elbabaa, MD, Jennifer Ahl, RN (Akron, OH), Thomas Kuivila, MD, Alan Gurd, MD, Mark Luciano, MD, PhD (Cleveland,OH)

ABSTRACT:

Introduction:

Ideally, early treatment of spasticity in children with cerebral palsy reduces need for subsequent orthopedic releases. However, in some cases both neurosurgical treatment and release of already-developed contractures is required. We developed a protocol of simultaneous neurosurgical (ITB or SDR) and orthopedic treatment under one anesthesia in order to reduce the number of general anesthesias in this at-risk group. This study reviews the outcome and complication rate in 24 patients undergoing the combined procedure over a three year period.

Methods: All patients were screened in our multidisiplinary spasticity clinic and were candidates for selective dorsal rhizotomy (n=17) or intrathecal baclofen (n=7). Tendon releases variably included hamstrings, heel cords and abductors. Follow-up period ranged from 4 weeks to 3 years.

Results: Age at surgery ranged from 4-19 years with a 16/8 male predominance. While spasticity response to SDR and ITB appears comparable, casts required by the releases impeaded assessment and delayed the onset of physical therapy. A high rate of infection and wound problems was seen in this group with 2 infected SDR incisions and 2 ITB pumps removed. Although the reduction in spasticity may reduced spasm after tendon release in some patients, one patient required cast removal secondary to severe pain.

Conclusions: Tendon release performed in the same setting with either SDR or ITB may reduce surgical exposures and may ultimately result in good outcome. However, the multiple incisions and casting required in tendon releases may increase the post-op risk of wound problems and infection.

36 Inside-Outside Technique for Occipitocervical Spine Fixation and Bone Grafting in Children

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ABSTRACT: Occipitocervical fusion and fixation is a challenge in children due to many factors. Occipital techniques can be divided into two types: 1) outside-inside (screws/wires are introduced from outside to inside of skulls); 2) inside-outside (placement of screws from inside through burr holes) with locknuts securing the screws to cervical fixators. From 1995-2000, seventeen patients underwent inside-outside occipitocervical fixations, ages 3-17 years (9 girls, 7 boys). Indications for surgery included congenital anomalies, developmental instability, dysplasia, instability after neoplasia resections, and trauma. Two patients had prior operative procedures with failed fusions. Autograft was used in all patients. Fixation was achieved with plates or rods. Plates or rods were secured with screws into the articular masses; wires, if screws were not possible. No intraoperative complications. Two patients were placed into halos. Patients followed over the last four years have achieved successful maturation of the graft, except for an 8-year-old boy (Down's Syndrome); re-operation, the internal fixators were well-seated, new graft was placed. Complications included superficial skin-breakdown from collar pressure, and one loosened nut after three months. The nut was replaced. All children are progressing well. The inside-outside method offers special advantages over outside-inside techniques in the children. Screws are not placed in blind fashions; the flat surface of the screw head rests next to dura, and diameters of screw heads can be increased, adding to pullout strengths. There is no concern about occipital thickness and no wires cutting through thin bone. This technique is ideally suited for younger patients.

37 Surfactant Mediated Tissue Protection in Experimental Brain Injury

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ABSTRACT:

Introduction: The surfactant, Poloxamer 188 (P188), has been found to protect against tissue injury in a variety of experimental models. The mechanism of protective action may involve stabilization of membrane integrity. We have investigated the role of P188 in the reduction of tissue injury in a model of brain injury in the rat.

Methods: Twenty nine Spague Dawley rats underwent stereotactic injection of 120 nmol of quinolinic acid into the striatum and subsequently received intracisternal injection of vehicle or P188 (40mg/kg) at five minutes and/or four hours after the lesions were made. Rats were sacrificed after one week and their brains examined for response to the injection.

Results: Striatal injection of the toxin produced a stereotypic lesion with necrosis and inflammation around the site of injection in all control animals (100%, n=7). Intracisternal surfactant, injected at both time points, reduced the number of animals showing evidence of tissue damage and necrosis to 22% (n=8). The timing of the injection also showed differential effects, with the 5 minute injection resulting in less damage (57%, n=7) than a 4 hour injection (87.7%, n=7).

Conclusion: A synthetic surfactant molecule, P188, shows positive protective effects in reducing necrosis and tissue injury after injection of a neurotoxin into the rat striatum. Further deliniation of the neuron?specific effects of the molecule should help determine its potential clinical utility.

38 Infant Homicide form Child Abuse in Los Angeles County

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ABSTRACT: Infant and childhood deaths from abuse are frequently due to head trauma. We reviewed data compiled by a multi-agency child death review team in Los Angeles County.

In this population of 2.4 million infants and children, 191 child deaths were investigated by the coroner over 12 months. Accidents accounted for 84 deaths, commonly due to drowning or maternal substance abuse. Sixty-one deaths were from homicide, 20 from suicide, and 26 undetermined. Forty-five of the 61 cases of homicide were caused by caretakers or family members. 62 percent of perpetrators were male. Homicides were five times as common with African Americans and twice as common with Hispanics Caucasians.

Forty-four percent of victims were under one year of age. One-third of cases had a previous record of child protective services. The cause of death in homicides was head trauma (27%), multiple trauma (22%), gunshot wounds (16%), suffocation (13%), and abdominal trauma (9%). 20% of these families had a history of domestic violence, and 20% had a history of substance abuse.

Neurosurgeons should maintain a high level of suspicion for abuse in head-injured patients, and suspicion should be high in families with a history of abuse or domestic violence. Preventive efforts must focus on ethnic minority groups, and particular attention should be directed at detecting abuse in developmentally delayed children.

39 Predictive Value of Serial Computed Tomography Following Post-Traumatic Subarachnoid Hemorrhage

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ABSTRACT: Serial CT scans of the head have become an integral part of patient management after acute head trauma. The optimization of resource utilization, however, dictates that we limit scans to high yield situations. Traditionally, specific findings on an initial head scan have been interpreted to be a harbinger of clinical deterioration. We set out to test this hypothesis for isolated post-traumatic subarachnoid hemorrhage in the pediatric population. We retrospectively identified patients with post-traumatic subarachnoid hemorrhage over the past five years from our pediatric traumatic database. Seventeen patients were found to have isolated subarachnoid hemorrhage, serial noncontrast CT scans, and adequate clinical follow-up. All seventeen patients remained clinically stable or improved, and none showed radiographic progression. These results suggest that subarachnoid hemorrhage alone is an insufficient reason to obtain a follow-up scan. A larger series is presently being analyzed to further investigate this conclusion as well as to determine which factors are most predictive of clinical deterioration.

40 MRI Spectroscopy in Pediatric Head Injury

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ABSTRACT:

Methods: 10 patients with varying types of pediatric head injury were enrolled in the study. Glascow Outcome was obtained for 3 month post injury versus 6 month post injury.

Data: Using a 15 point MRI scoring system and a short echo MR spectoscopy refered to as STEAM voxel data was obtained. Using fast fourier transform of data sets, Lactate, Creatine (Cre), Choline (Cho), N-Acetyle aspartate(NAA), signals were measure as peak areas. A t-test using mean metabolic ratios (NAA/Cre and NAA/Cho Cho/Cre) with good versus poor outcome.

Results: A positive correlation of poor outcome and high peak mean ratios was obtained. Also a positive correlation of the presence of lactate and poor outcome was obtained.

Conclusions: MRI Spectroscopy is a useful adjunct test in the analysis of outcome scaling in pediatric head injury.

41 Portable CT May be a Valuable Adjunct in Certain Pediatric Neurosurgical Procedures

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ABSTRACT:

Introduction: While performing certain procedures a pediatric neurosurgeon may desire the added anatomic information that can be provided by a portable CT unit.

Materials and Methods: We have employed in selected pediatric neurosurgical procedures a CT scanner (Philips Tomoscan M) that draws standard wall electrical outlets, has a translating gantry, and can be pushed from room to room. We coupled it to an image-guidance system (Radionics OTS) for online updating with intraoperative images.

Results: The scanner has proven most useful in bur hole procedures where the margin of error is small. It was employed in four cases of isolated fourth ventriculomegaly. In these cases, the coupling of the scanner to an image-guidance system allowed the planning of a three-dimensional trajectory of the catheter to the fourth ventricle. Once placed, the catheter position was inspected with CT, and repositioned if necessary. The unit has been helpful for stereotactic biopsies in younger children who require general anesthesia for placement of a stereotactic frame. In such cases it has permitted the induction of anesthesia, the application of the frame, the stereotactic CT, and the biopsy all to take place without moving the child from the operating table.

Conclusion: Intraoperative portable CT is a useful adjunct in the guidance and monitoring of bur hole procedures . However, at open procedures where the exposed pathology furnishes direct visual and tactile cues to the surgeon, intraoperative CT is of less value.

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