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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Jointly Sponsored by American Association of Neurological Surgeons
Disclaimer

All drugs and medical devices used in the United States are administered in accordance with Food and Drug Administration (FDA) regulations. These regulations vary depending on the risks associated with the drug or medical devices compared to products already on the market, and the quality and scope of the clinical data available.

Some drugs and medical devices demonstrated or described in 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

1984  Arno Fried: A Laboratory Model of Shunt-Dependent Hydrocephalus
1985  Anne-Christine Dehaim: The Shaken Baby Syndrome
1986  Robert E. Breese: CSF Formation in Acute Ventriculitis
1987  Marc R. Dellepico: Shunt-Induced Reversal of Periventricular Pathology in Experimental Hydrocephalus
1988  Scott Falch: Rear Seat-Lap Belts. Are They Really "Safe" for Children?
1989  James M. Herman: Televised Cord as a Cause of Seizures in Children with a Myelomeningocele
1990  Christopher D. Heffner: Basilar Posa Attracts Its Cortical Innervation by Chemotropic Induction of Collateral Branch Formation
1991  P. David Adelson: Reorganization of the Cortical-Tentorial Pathway Following Neonatal Cerebral Hemispherectomy in Cats
1992  David Primi: Effects of Biologically Delivered Neurotrophins in Animal Models of Neural Degeneration
1993  Monica C. Wohl: Metabolic Demonstration of Retained CNS Function in the Rabbit Model of Infantile Hydrocephalus
1994  Ellen Shaver: Experimental Acute Subdural Hemostasis in Infant Pigs
1995  Seyed M. Eshadian: Correlation of Chromosome 1p 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 Rancer: Implantation of Medulloblastoma Cells into Collagen Type I Gel: 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

Annual Winter Meeting Sites

1972  Cincinnati
1972  Copley
1974  Los Angeles
1975  Philadelphia
1976  Toronto
1977  Cleveland
1978  Philadelphia
1979  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  Phoenix
1996  Chattanooga
1997  Charleston
1997  New Orleans
1998  Indianapolis
1999  Atlanta
2000  Coronado
2001  New York
2002  Phoenix
2003  Miami

Pediatric Section Chairmen

1972-74  M. Peter Sayres  1985-87  William R. Cheek
1974-75  Frank Anderson  1987-89  David G. McLane
1975-76  Kenneth Shulman  1989-91  Donald H. Riepe
1976-77  E. Bruce Hendrick  1991-93  R. Michael Scott
1977-78  Frank Nolin  1993-95  Arthur Martin
1979-81  Fred J. Epstein  1997-99  Marion L. Walker
1981-83  Joan L. Vesely  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  Maurice Chouf
1990  Roger Guillemin  1997  Louis Shum
1992  Joseph Murray  2000  Postponed due to illness
1993  Ellen Alexander, Jr.  2001  Donald H. Beigel

Raimondi Lecturers
1978  E. Bruce Hendrick  1989  Martin Eichlerberger
1979  Paul C. Bucy  1990  George R. Leopold
1980  Floyd Gilles  1991  Judith Folkman
1981  Panel Discussion  1992  Olaf Flodmark
1982  Panel Discussion  1993  Maurice Albin
1983  Derek Harley-Nash  1994  Blaise F.D. Bourgeois
1984  Anthony E. Gallo, Jr.  1995  Robert H. Podena
1985  Frank Nolin  1996  Samuel S. Flint
1987  Dale Johnson  1998  Robert A. Zimmerman
1988  Joseph J. Volpe  1999  David B. Schacteroff
1999  TBA
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 at 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 pediatrics 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.
Exhibitor Listing

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

Acra-Cut, Inc.
989 Main Street
Acton, MA 01720
(978) 363-9186

American Association of Neurological Surgeons

5550 Meadowbrook Drive
Rolling Meadows, IL 60088
(847) 576-0060

American Surgical Sponges, Div
82 Sanderson Avenue
Lynn, MA 01902
(781) 592-7200

Aspen Medical Products, Inc.
1901 Olivos Avenue
Long Beach, CA 90804
(800) 285-2776

BrainLAB, Inc.
100 Marlin Parkway, Suite 305
Redwood City, CA 94063
(650) 494-7240

Carl Zeiss, Inc.
One Zeiss Drive
Thornwood, NY 10594
(914) 442-6500

CBYON, Inc.
2275 East Bayshore Road, Suite 101
Palo Alto, CA 94303
(650) 822-1100

Codman, a Johnson & Johnson Company
325 Paramount Drive
Raynham, MA 02767
(508) 880-8333

Compass International, Inc.

Cascade Business Park
919 37th Avenue NW
Rochester, MN 55901
(507) 281-2143

Hydrocephalus Association

670 Market Street, Suite 700
San Francisco, CA 94102
(415) 732-1740

Integra Neurosciences

103 Morgan Lane
Plainsboro, NJ 08536
(800) 275-0500

KLS-Martin, LP

P.O. Box 504249
Jacksonville, FL 32250
(904) 641-7746

Leica Microsystems, Inc.

110 Commerce Drive
Allendale, NJ 07401
(800) 525-0355

Macro Pore, Inc.

6740 Top Gun Street
San Diego, CA 92121
(619) 458-0900

Medtronic Midas Rex

4600 N. Beach Street
Ft. Worth, TX 76137
(817) 788-6400

Medtronic Neurological

889 53rd Avenue NE
Minneapolis, MN 55431
(763) 514-8000

Medtronic PS Medical

125 Cremona Drive
Goleta, CA 93117
(805) 969-1546
Exhibitor Listing

Medtronic Surgical Navigation Technologies
828 Coal Creek Circle
Louisville, KY 80227
(888) 560-8860
Booth 39

Moller Microsurgical
3600 Concordeview Drive
Mason, OH 45040
(513) 386-7255
Booth 32

NMT Neurosciences
3450 Corporate Way, Suite A
Duluth, GA 30096
(678) 282-9542
Booth 19

Phoenix Biomedical Corp.
2405 General Armistead Avenue
Norristown, PA 19403
(610) 528-5000
Booth 29

Radionics, a Division of Tyco Healthcare Group LP
22 Terry Avenue
Burlington, MA 01803
(781) 272-1233
Booth 15

W. B. Saunders
3475 S. 22nd St.
Carrollton, TX 75006
(760) 944-9966
Booth 24

W. Lorenz Surgical
1520 Tradepoint Drive
Jacksonville, FL 32218
(904) 741-9210
Booth 30

Acknowledgements

The American Association of Neurological Surgeons and Congress of Neurological Surgeons Section on Pediatric Neurological Surgery wish to thank the following for their generous contributions to the Annual Meeting.

Diamond Sponsor: $10,000+
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Emerald Sponsor: $5,000 - $9,999
Medtronic Neurological

Sapphire Sponsor: $500 - $4,999
American Surgical Sponges, Div
Carl Zeiss, Inc.
Codman, a Johnson & Johnson Company
Medtronic Midas Rex
Medtronic Surgical Navigation Technologies
NMT Neurosciences
Radionics, a Division of Tyco Healthcare Group LP

Thank you for your support!
About the AANS/CNS Section on Pediatric Neurological Surgery

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Secretary-Treasurer: J. Richmond Abbott, III, MD
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Douglas L. Beckmann, MD (2000)
Philip H. Cogen, MD, PhD (2000)
Ann Marie Flannery, MD (1999)
Sarah J. Gaskill, MD (1999)

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Nominating Committee: Chairman: Marion L. Walker, MD (1999)
Rules and Regulations: Chairman: Alan R. Cohen, MD (1999)
Membership Committee: Chairperson: Ann-Christine Duhaime, MD (1997)
Program and Continuing Education Committee: Chairman: Frederick A. Bop, MD (1997)
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Annual Meeting Chairman: Hector E. James, MD
Ex Officio Members: John P. Laurent, MD
J. Richmond Abbott, III, MD
Future Annual Meeting Chairman:
2001: J. Richmond Abbott, III, MD
2002: Harold L. Rekate, MD
2003: Glenn Morrison, MD
2004: Mitchell S. Berger, MD
Warwick J. Peacock, MD

Ad Hoc Committees

Co-Chairperson: David McLeod, MD, PhD
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Rodger Hodgins, MD
Paul Steinbok, MD
Liaison to the AANS Sections: Harold L. Rekate, MD (1997) MD
Liaison to the American Academy of Pediatrics: Joseph H. Piant, Jr., MD (1997)
Liaison to the Joint Council of State Neurosurgical Societies: Michael Henifur, MD
Representatives to the Quality Assurance Committee: Chairman: Paul A. Gruhn, MD (1999)
Sarah J. Gaskill, MD (1999)
James Drake, MD (1999)
Representative to the Washington Committee: Marion L. Walker, MD (1998)
Representative to Referral Guidelines Committee: Harold L. Rekate, MD (1997)
Representatives to Practice Guidelines Committee: Thomas G. Luerssen, MD (1996)
John Koul, MD (1996)
Representatives to Outcomes Committee: Bruce A. Kaufman, MD (1997)
John Koul, MD (1997)
Representative to the Neurosurgical Surgery Political Action Committee: Thomas G. Luerssen, MD (2000)

Traveling Fellowship Committee: Chairman: R. Michael Scott, MD
Distinguished Service Award: Chairman: Robin P. Humphreys, MD
NEUROSURGERY:ON-CALL Editorial Board:
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Editorial Board Members:
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Keith Aronsky, MD
Mark S. Dus, MD
James Drake, MD
David Jemenez, MD
John Keats, MD
Michael Partington, MD
James Rutka, MD
Marion L. Walker, MD
Publications Committee: Chairman: Sarah J. Gaskill, MD
<table>
<thead>
<tr>
<th>Time</th>
<th>Session Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thursday, December 7, 2000</td>
<td>continued</td>
</tr>
<tr>
<td>2:35 pm – 2:45 pm</td>
<td>13. Endovascular Management of Pediatric Lesions</td>
</tr>
<tr>
<td>2:45 pm – 2:55 pm</td>
<td>14. Surgical Treatment of Spinal Arteriovenous Malformations in the Pediatric Population</td>
</tr>
<tr>
<td>2:55 pm – 3:05 pm</td>
<td>15. Stereotactic Radiosurgery for Pediatric Intracranial Arteriovenous Malformations</td>
</tr>
<tr>
<td>3:05 pm – 3:30 pm</td>
<td>Refreshment, Snacks and Exhibit Viewing—Regent/Viceroy Rooms</td>
</tr>
<tr>
<td>3:30 pm – 3:50 pm</td>
<td>16. Growth Rate of Vestibular Schwannomas in Neurofibromatosis Type-2 early in Life</td>
</tr>
<tr>
<td>3:40 pm – 3:50 pm</td>
<td>17. Salvage Therapy after Relapse in Medulloblastoma</td>
</tr>
<tr>
<td>3:50 pm – 4:00 pm</td>
<td>18. Giant Cell Glioblastomas of Pediatric Population: A Study of Eighteen Cases</td>
</tr>
<tr>
<td>4:00 pm – 4:10 pm</td>
<td>19. Pediatric Ependymoma (40 In 36 months)</td>
</tr>
<tr>
<td>4:10 pm – 4:30 pm</td>
<td>20. Brainstem Gliomas: A 10-Year Institutional Review</td>
</tr>
<tr>
<td>4:30 pm – 4:40 pm</td>
<td>21. Management of Thalamic Tumors in Children</td>
</tr>
<tr>
<td>4:40 pm – 4:50 pm</td>
<td>22. Diabetes Insipidus and Serum Sodium in the Perioperative Period of Cranial Resection</td>
</tr>
<tr>
<td>4:50 pm – 5:00 pm</td>
<td>23. Pediatric Cranial Resection; Long Term Follow up Following Aggressive Surgical Resection</td>
</tr>
<tr>
<td>5:00 pm – 6:00 pm</td>
<td>Annual Business Meeting—Empress Room</td>
</tr>
<tr>
<td>7:00 am – 7:30 am</td>
<td>Registration— objected</td>
</tr>
<tr>
<td>7:30 am – 8:00 am</td>
<td>Speaker Preview Room—Board Room</td>
</tr>
<tr>
<td>8:00 am – 8:30 am</td>
<td>Continental Breakfast with Exhibit Viewing—Regent/Viceroy Rooms</td>
</tr>
<tr>
<td>8:30 am – 9:00 am</td>
<td>Exhibit and Poster Viewing Hours—Regent/Viceroy Rooms &amp; Grande Hall Lower</td>
</tr>
<tr>
<td>9:00 am – 9:30 am</td>
<td>24. Aprostol: A Pharmacologic Therapy that Reduces Blood Loss in Craniofacial Surgery</td>
</tr>
<tr>
<td>9:30 am – 10:00 am</td>
<td>25. Multiple Evolution Spiral Osteotomy for Cranial Reconstruction: Surgical Technique and Early Results in Ten Patients</td>
</tr>
<tr>
<td>10:00 am – 10:30 am</td>
<td>26. Endoscopic Assisted Versus Open Strip Cranectomy for Sagittal Craniosynostosis: A Retrospective Review</td>
</tr>
</tbody>
</table>
Learning Objectives

Scientific Session VI—Hydrocephalus

The participant should be able to:
- Evaluate the use of shunt procedures.
- Recognize the values of alternative treatment options for hydrocephalus.

8:30 am – 8:40 am
27. Sagittal Cranioptosis: Outcome Assessment for Two Methods of Intervention
Paul C. Franzel, MD, PhD; Jayesh Panchal, MD (Dept of Plastic Surgery, Oklahoma City, OK); J. L. March, MD (St. Louis, MO); T. S. Park, MD (St. Louis, MO); R. Kusinman, 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 Cranioptosis
Benjamin C. P. Lee, MD, Mokhtar Gudo, MD (St. Louis, MO); T. S. Park, MD (St. Louis, MO)

8:50 am – 9:00 am
29. Developmental Delays in Children with Non-Syndromic Cranioptosis and Deformation Plagiocephaly
Paul C. Franzel, MD, PhD; Hamid Amini-Beykha, MD (Oklahoma City, OK); Robin Gutwirth, PhD (Oklahoma City, OK); Vika Cuk, MD (Oklahoma City, OK); Jayesh Panchal, MD (Oklahoma City, OK); Barbara Neus, PhD (Oklahoma City, OK); Norman Levine, MD (Oklahoma City, OK)

9:10 am – 10:00 am
Scientific Session VI—Hydrocephalus—Empress Room
Moderators: P. Steinhok, MD; J. G. Monk, MD

9:10 am – 9:20 am
30. Surveillance for Neuritis in Routine Shunt Evaluation
Scott W. Eton, MD, R. Shams Tabba, MS, PA-C (Birmingham, AL); Paul A. Graft, MD (Birmingham, AL); W. Jerry Oaks, MD (Birmingham, AL)

9:20 am – 9:30 am
31. The Application of Controlled, Intracranial Intraventricular Hypertension (CIVH) in Patients with Shunt Malfunction
William E. Butler, MD, Saad Khan (Montreal, Quebec, Canada); Paul H. Chapman, MD (Boston, MA)

9:30 am – 9:40 am
32. Infection Rates in the Treatment of Lateral Venous Hydrocephalus with Endoscopic Fenestration
Remaja J. Ostendorf, MD (Memphis, TN); Stephanie L. Ehnhann, MD (Memphis, TN); Michael Malbouisson, MD (Memphis, TN); Frederic Boy, 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. Hadar, MD, FRCS(c); Jim Drake (Toronto, Ontario, Canada); Doug Cochrane (Vancouver, BC, Canada); John Kestle (Shah 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. Rouza, MD, Paul A. Graft, MD
### Scientific Program

#### Friday, December 8, 2000

<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
<th>Location</th>
<th>Speakers</th>
</tr>
</thead>
<tbody>
<tr>
<td>12:00 p.m. - 1:00 p.m.</td>
<td>Lunchen Poster Sessions—Grande Hall Lower</td>
<td>Posters Discussions (1) — Empress Room</td>
<td>Moderators: J. Wofz, MD; M. S. Edwards, MD</td>
</tr>
<tr>
<td>1:00 p.m. - 1:45 p.m.</td>
<td>Posters Discussion (1) — Empress Room</td>
<td>Steve Baker, MD, MSAF</td>
<td></td>
</tr>
<tr>
<td>1:45 p.m. - 2:00 p.m.</td>
<td>Posters Removal—Grande Hall Lower</td>
<td>Raimondi Lecture 2000—Empress Room</td>
<td>Steve Barron, MD, MSAF</td>
</tr>
<tr>
<td>2:00 p.m. - 2:30 p.m.</td>
<td>Refreshments, Snacks and Exhibit Viewing—Regency/Vicevoy Rooms</td>
<td>Scientific Session VIII—Trauma—Empress Room</td>
<td>Moderators: R. M. Scott, MD; T. C. Lucern, MD</td>
</tr>
<tr>
<td>2:30 p.m. - 3:00 p.m.</td>
<td>44. A Targeted Program of Parent Education at the Time of a Child’s Birth can Slightly Reduce the Incidence of Shaken Baby Syndrome: The Western New York Experience</td>
<td>Mark S. Dias, MD, MSAF; Paulina Mancz, MD; FAAP (Buffalo, NY)</td>
<td></td>
</tr>
<tr>
<td>3:00 p.m. - 3:50 p.m.</td>
<td>45. NonAccidental Pediatric Head Trauma: Diffusion Weighted MRI Findings</td>
<td>Daniel Y. Sub, MD, PhD, Patricia Davila, MD (Atlanta, GA); Karna Hopkins, MD (Atlanta, GA); Nancy Pajman, MD (Atlanta, GA); Timothy Maguire, MD (Atlanta, GA)</td>
<td></td>
</tr>
<tr>
<td>3:50 p.m. - 4:00 p.m.</td>
<td>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</td>
<td>Mark S. Dias, MD, MSAF; Paulina Mancz, MD; FAAP (Buffalo, NY); Carmen Carone, MD (Buffalo, NY); Veeti Li, MD (Buffalo, NY)</td>
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</tr>
<tr>
<td>4:00 p.m. - 4:10 p.m.</td>
<td>47. Decompressive Craniectomy: the Second Tier Therapy of Choice in the Treatment of Uncontrollable Post-traumatic Intracranial Hyperatenion in Children?</td>
<td>Waltraud Klein-Weber, MD, Michael R. Goebel, MD, PhD, Clinic of Neurosurgery; Ernst-Moritz-Arnold-University, Greifswald, Wolfgang Wagner, MD, Clinic of Neurosurgery; Ernst-Moritz-Arnold-University, Greifswald</td>
<td></td>
</tr>
<tr>
<td>4:10 p.m. - 4:20 p.m.</td>
<td>48. Neurologic Ski Injuries in Children: Morbidity Assessment and the Impact of Ski Helmet Use in a Study of Skiing Children</td>
<td>John B. Harris, MD</td>
<td></td>
</tr>
<tr>
<td>4:20 p.m. - 4:30 p.m.</td>
<td>49. Variability in the Definition and Treatment of SCIWORA: A Survey of Pediatric Neurosurgeons</td>
<td>Mei Weng, MD, Mark S. Dias, MD, MSAF (Buffalo, NY); Veeti Li, MD (Buffalo, NY)</td>
<td></td>
</tr>
<tr>
<td>4:30 p.m. - 4:40 p.m.</td>
<td>50. A Prospective Study of the Utility of MRI in the Diagnosis and Treatment of Transient Neurologic Deficits Following Spinal Cord Injury in Children</td>
<td>Susan R. Durham, MD, Albert Tolkin, MD (Philadelphia, PA); John Bookvar, MD (Philadelphia, PA); Peter Sun, MD (Oakland, CA)</td>
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</tr>
</tbody>
</table>

*Please see Learning Objectives above.*
Scientific Program

Saturday, December 9, 2000

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>7:00 am - 12:00 noon</td>
<td>Registration for Practice Management—Grande Hall Foyer</td>
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<tr>
<td>7:00 am - 9:00 am</td>
<td>Continental Breakfast with Exhibit Viewing—Regents/Viceroy Rooms</td>
</tr>
<tr>
<td>7:00 am - 11:00 am</td>
<td>Exhibit Viewing Hours—Regents/Viceroy Rooms</td>
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<tr>
<td>7:30 am - 7:30 pm</td>
<td>Speaker Preview Room—Board Room</td>
</tr>
<tr>
<td>8:00 am - 8:00 pm</td>
<td>Golf (optional)</td>
</tr>
<tr>
<td>8:00 am - 1:00 pm</td>
<td>Practice Management and CPT Coding and Billing for Pediatric Neurosurgery*—Empress Room</td>
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<tr>
<td>Faculty: John Pope, MD</td>
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<tr>
<td>10:00 am - 10:30 am</td>
<td>Refreshments, Snacks and Exhibit Viewing—Regents/Viceroy Rooms</td>
</tr>
<tr>
<td>11:00 am - 1:00 pm</td>
<td>Optional Meeting Extension—Empress Room</td>
</tr>
<tr>
<td>&quot;My Shunting is Better than Yours&quot;</td>
<td></td>
</tr>
<tr>
<td>Moderators: D. A. Bruce, MD — H. E. James, MD</td>
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<td>Panelists: R. Abbott, MD — R. Humphreys, MD — J. Laurent, MD — T. G. Loertscher, MD — D. McLane, MD — H. L. Bhatia, MD — R. A. Sanford, MD — M. L. Walker, MD — J. H. Wisoff, MD</td>
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<td>2:00 pm - 2:30 pm</td>
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* Please see Learning Objectives above.
12 Synergistic Action of Genistein and Cisplatin on Growth Inhibition and Cytotoxicity of Human Medulloblastomas
Sami Khoshymn, MD, Paul L. Penar, MD (Burlington, VT); Sean M. Lew, MD (Burlington, VT); Steven L. Wald, MD (Cincinnati, OH); Gregor C. Masako, BS (Burlington, VT)

13 Predictive Value of MR Spectroscopy in Pediatric Brain Tumors
Amir Vakoussi, MD, Gregory W. Balthasar, MD (Columbus, OH); Jerome BasiU, MD (Columbus, OH); Edward J. Kosek, MD (Columbus, OH)

14 Intracranial Epidermoidomas in Children
Benjamin M. Pinti, MD, Frank Van Calsenbergh, MD (Leuven, Belgium); Christian Plota, MD (Leuven, Belgium); Jacques Breticha, MD (Brussels, Belgium)

15 Supratentorial Oligodendrogliomas in Children and Adolescents
Daniel C. Bowers, MD, Linda Margraff (Dallas, TX); Deborah L. Douce (Dallas, TX); Armin F. Mohns (Dallas, TX); Bradley Weprin (Dallas, TX); Derek A. Bruce (Dallas, TX)

16 Pediatric Dorsally Exophytic Brainstem Gliomas: Value of Aggressive Surgical Resection
Rebecca J. Osterbeck, MD, Dwight E. Brown, MD (Memphis, TN); Richard L. Heiden, MB (Memphis, TN); Robert A. Sanford, MD (Memphis, TN); Larry C. Kueh, 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
Benjamin M. Pinti, MD, Sacha Selberg, MD, Patrick Van Bogaert, MD, PhD, Serge Goldman, MD, PhD, Delphine Lejeune, MD, Marc Lavieire, MD, PhD (Brussels, Belgium); Jacques Breticha, MD, PhD (Brussels, Belgium)

18 Enhanced Prospersive Planning Using Composite Digital Holograms Coregistered with Frameless Stereotaxy for Pediatric Low Grade Glioma Surgery
John D. Collins, MD, Raymond A. Schuch, MS (San Francisco, CA); Michael N. Dalton, BSc (Provo, UT); Stephen J. Hart, BSc (Provo, UT)

19 Failure of Autogenous Cranialoplasty Following Decompressive Cranectomy in Children
Gerald A. Gravis, MD, Matthew Jolin, BS, Gregary D. Potz, MD (Seattle, WA); Joseph R. Grose, MD, Richard G. Ellenbogen, MD (Seattle, WA); Theodore S. Robins, MD (Seattle, WA); H. Richard Wins, MD (Seattle, WA); John D. Looser, MD (Seattle, WA)

20 Craniosynostosis in the Percinat Rat Using Methyl-2-Cyanocrylate: a Neuroanatomical Study
Khulud A. Sadi, MD, Walter Low, PhD (Minneapolis, MN); Cornelius H. Lam, MD (Minneapolis, MN)

21 Craniosynthesis in the Young Child: Successful Use of Rib
Derek A. Taggart, MD, Arnold H. Mones, MD (Iowa City, IA)

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

23 Pluronite Surface Polymer as a New Bone Hemostatic Agent in Children That Does Not Impair Osteogenesis
Michael Y. Wang, MD, John Armstrong, PhD, J. Gordon McComb, MD (Los Angeles, CA); Michael L. Levy, MD (Los Angeles, CA)

24 Stress-sensitive Calcium-channel Receptors in Developing Rat Cranial Sutures
Kristen Fryburg, MD, Jack Yu, MD, James Berkus, PhD, Ann-Marie Flannery, MD (Angiota, CA)

25 The Safety of Tapping a Shunt
Mark D. Kruger, MD, J. Gordon McComb, MD (Los Angeles, CA); Michael L. Levy, MD (Los Angeles, CA)

26 A Proximal Ventricular Catheter Occlusion Model and Comparison of Catheter Coring Techniques
Mark S. Gerber, MD, Aaron Kamau (Poo, UT); Kim H. Manwaring, MD (Phoenix, AZ)

27 Duration of Antibiotic Therapy for the Treatment of Shunt Infections: A Retrospective Review
William E. Whitlaid, MD, MPH, John R. W. Koolth, MD (Salt Lake City, UT)

28 The Surgical Management of Multiloculated Hydrocephalus
Mark D. Kruger, MD, J. Gordon McComb, MD (Los Angeles, CA); Michael L. Levy, MD (Los Angeles, CA)

29 Aqueductal Stenosis: Endoscopic Aqueductoplasty and Aqueductal Stenting as a Neat Alternative to Third Ventriculostomy
Aaron Mohantas, M Ch, Thimapa Hegle (Bangalore, India); M. K. Vasudha (Bangalore, India); S. Prasanth (Bangalore, India); S. Babesh (Bangalore, India)

30 Laparoscopic Distal Catheter Evaluation to Rule Out Ventriculoperitoneal Shunt Failure and Infections
Nicholas Theodore, MD, Howard Bains, MD (Phoenix, AZ); Donna Wallan, RN, MS, CNP (Phoenix, AZ); Geoffrey Zoby, MD (Phoenix, AZ); Raymond Shames, MD (Dep. of Surgery) (Phoenix, AZ); Harold L. Relate, MD (Phoenix, AZ)

31 The Codman Hakim Programmable Valve as a Replacement Valve in Complicated Hydrocephalus
Rachana Tyagi, MD, Kartin S. Berbraun, MD (Philadelphia, PA)

32 Venous Overdrainage in Silt Ventriculostomy Syndrome
Sanjeev Sund, MD, Kaveh Bazami, MD, PhD (Detroit, MI); Alex J. Canady (Detroit, MI); Steven D. Ham, DO (Detroit, MI)

33 In-Vitro Evaluation and Theoretical Designs of VP Shunts Using Experimental Test-Bench and Computer-Simulation
Martin Mootz, PhD, Juriu Lin, MD (East Penn, PA); Robert Hart, PhD (Houston, TX); William Grieve, MD (Pittsburgh, PA)

34 Osteotomy of Sciosis After Primary Spinal Cord Unstenting
Michael H. Handler, MD, FACS, FAPSA, Brian Callahan, BA (Denver, CO)

35 Simultaneous Orthopedic and Neurosurgical Treatment of Cerebral Palsy Spasticity
Santeri K. Elhalai, MD, Jennifer Abl, RN (Akron, OH); Thomas Koivinen, MD, Alan Gurd, MD, Mark Luciano, MD, PhD (Cleveland, OH)
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36 Inside-Out Technique for Occipitocervical Spine Fixation and Bone Grafting in Children
George T. Husein, MD, T. Glenn Pult, MD (Little Rock, AR), Richard E. Mcauliffe, MD (Little Rock, AR), Osama Al-Mohy, MD (Little Rock, AR), Frederick A. Beep, MD (Memphis, TN), Kemal I. Arnautovic, MD (Little Rock, AR)

37 Surfactant Mediated Tissue Protection in Experimental Brain Injury
Daniel J. Cuny, MD, David Wright, PhD, Raphael Leo, MD, Un Kang, MD, David Fium, MD (Chicago, IL)

38 Infant Homicide Form Child Abuse in Los Angeles County
Michael Y. Wang, MD, Pamela Griffith, MSN (Nebraska, IA); Anthony Kim, MD, J. Gordon McGinn, MD (Los Angeles, CA); Michael Levy, MD (Los Angeles, CA)

39 Predictive Value of Serial Computed Tomography Following Post-traumatic Subarachnoid Hemorrhage
Masanori C. Wang, MD, Lori McBride, MD (Denver, CO); Robert E. Breeze, MD (Denver, CO)

40 MRI Spectroscopy in Pediatric Head Injury
Jeffrey E. Castrambie, MD, John Collins, MD (Loma Linda, CA); Jeff Lobe, MD (Loma Linda, CA); Austin Cohen, MD (Loma Linda, CA)

41 Portable CT May be a Valuable Adjunct in Certain Pediatric Neurosurgical Procedures
William S. Butler, MD, Paul H. Chapman, MD (Boston, MA)

Scientific Oral Abstracts

1 Intrauterine Myelomeningocele Repair: An Update

AUTHORS: Noel B. Tulipan, MD, Joseph F. Bromer, 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 these patients are now one year old or greater. Of those, 30 (68%) have required a VP shunt. While this percentage is an improvement over published shunt rates for patients with spina bifida (80-90%), it remains unclear whether the risk of surgery justifies 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 1 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.

AUTHORS: Sharmantshik Robinson, MD, Kasia Patala, 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 oligodendrocyte loss is seen 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 aberrant cytokine expression that disrupts growth factor regulation of oligodendrocyte development. Methods: A rat prenatal ischemia model was used to examine the disruption of oligodendrocyte lineage development and cytokine expression using immunohistochemistry, proliferation, and apoptosis assays. Animal model data were compared 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 perinatal 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 WML 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 Tropic Support to the Developing Striatum: Role of Glutamatergic Afferents

AUTHORS: Sandeep Mittal, MD, MA, Alonzo-Vargas, MD (Montreal, PQ), R. Alavy, PhD (Montreal, PQ), F. D. Miller, PhD (Montreal, PQ), A. F. Sedikid, 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 (PD) 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. 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: Shinuyo Yamada, MD, Masayuki Shikata (Los Angeles), Minjung Sondag (Los Angeles), Stefan Blum (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 kainic injected into the cerebrospinal fluid. 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 Sylvaus of adult guinea pigs and the aqueduct completely blocked by gently pulsing cotton around the tube. Artificial CSF containing gelatin 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 rate of CSF drainage sites.

Results: Ventricular enlargement occurred within minutes and rapidly progressed in response to third ventricular injection. Also within minutes, gelatinism was noted to be present in high concentrations in the nasal cavities and periorbital region while there was little to none over the meninges of the hemispheres and in the region of the superior sagittal sinus. The ventricles rapidly deformed 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.

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

AUTHORS: Miriam Feudenc, MD, Rex A. Mora, Marvin D. Neilson, 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-acetylaspartate (NAA) signal (NAA/Cr ratio) in the pediatric brain, 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 without 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 atrophy 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.

Conclusions: 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 the NAA/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 posthemorrhagic 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 ventricular occlusion 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. FOHRs 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 age at the time of surgery. Infections occurred in 9 of 44 subgaleal shunts (20%) and 9 of the 26 reservoirs. A higher infection rate was also observed in the subgaleal patients following removal of the device and VPS placement (13.8% 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.
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7 Ten Children with Coccidioidomycosis Meningitis: Clinical Presentation, Treatment, and Long Term Prognosis

AUTHORS: Charles J. Winkel, MD, Kevin Ttermann, MD (Bakersfield, CA)

ABSTRACT: Coccidioidomycosis acquired by inhalation of infective spores may disseminate to extra-pulmonary locations. Dissemination to the cerebrospinal fluid washing 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 coccidioidomycoses in almost every case. Skin tests were uniformly negative. Urinary 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 positive CSF cultures (300-1200 WBC/mm) and required a ventriculoperitoneal shunt for treatment. 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 Fowler, PhD (Dallas, TX), Kathi Dominguez, PA (Dallas, TX), Nancy Bellini, MD (Dallas, TX), Dale Swift, MD (Dallas, TX), Derek Beuss, 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 5/6-12/96: 36 patients had tonsillar herniation and underwent surgery (CMIS), 36 had CM and no surgery (CMN), and 23 had no radiographic evidence of CM. Postoperative venous/N and during/N CSF flow and abnormal motion of the cerebellar tonsils/subarachnoid(BST) were documented. Symptoms included headaches, cranial nerve symptoms, and neurologic deficits. Baseline: Headaches (p equal to 0.003), cranial nerve deficits (p less than 0.0001) and neurologic deficits (p less than 0.0001) were more likely in CMN than CIM. Pre-operative BST (p less than 0.0001), V (p less than 0.0001) and D (p less than 0.0001) were different between CMIS and CIM (59% CIM 13/24 and 80% CIM 14/17) had BST on initial MRI. Post-operatively, 74% (14/19) had improvement in BST (89% CI = (0.49, 0.91)), 38% (4/24) in D (90% CI = (0.07, 0.78)), and 21% (5/24) in V in 99% CI = (0.07, 0.49). Cross tab analysis failed to show significant correlation between CMRI and preoperative symptomatology. Conclusion: There is abnormal BST and a decrease in VD in patients with CM. Radiographic improvement occurred after surgery. The clinical pattern rather than the CMRI weighted most heavily in the decision for surgery.

9 Outcome of Scoliosis After Chiari Decompression

AUTHORS: Michael H. Handler, MD, FAOC, FAAP, James M. Roh, MD, Patti Batchelier, RN, MSN, Mark A. Erickson, MD, Michael Olbran, 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 idiopathic scoliosis to diagnose and treat the Chiari I malformation may reduce the need for spinal fusion in some patients.

10 Craniovertebral Instability in Patients with Mucopolysaccharosis, Review of 30 Cases

AUTHORS: Rozsny A. Al Sallil, MB, BS, Abdulaziz Ghunemari, MD (Riyadh, Saudi Arabia), Pinar Onal, MD (Riyadh, Saudi Arabia)

ABSTRACT:

Background: Mucopolysaccharidoses are primary metabolic abnormalities of the carbohydrate metabolism. They are inherited storage diseases manifest by mental retardation, macrocephaly, corneal clouding, small stature and dwarfism as well as skeletal dysplasia. Generalized 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 craniovertebral instability.

Methodology: A retrospective review of all cases treated in our facility since 1980.

Results: 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 diseases 22, Morquio syndromes 20, others 5) was confirmed by a battery of investigations including skin biopsy. Twenty-five patients had a radiological complaint at the time of presentation: 16 of 25 had craniovertebral 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 craniovertebral instability. The reason for this is that most of these patients will eventually develop an airway problem due largely to mucopolysaccharidosis deposition, and the progression of the myopathy. 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 Puskitt, MDCM (Vancouver BC), Paul Steenboom, MB, FRSCS (Vancouver, BC)

ABSTRACT:

Purpose: To determine if XeNCT (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 C7 levels using a 5-minute inhalation of 8% Xenon. Arteriadiamne 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.
12 Complex Reconstruction/ Bypass Versus Trapping in Giant Intracranial Aneurysms in Children And Adolescents

AUTHORS: Michael L. Levy, MD, Lerry Kho, MD (Los Angeles, CA), J. Gordon McClure, 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 (1876). Of these 18 cases (ages 3 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 subarachnoid hemmorhage, 13/18 (72%) with more severe effect, and 6/18 (33%) with both. The locations of all aneurysms and failure rates are as follows, posterior circulation: 7/18 (1 failure, 3.5%), cortical bifurcation 5/18 (1 failure, 20%), distal anterior cerebral artery 3/18, proximal carotid artery 3/18 (3 failures, 100%) and pericallosal region 1/18. The operative modalities included clip ligation (5), ex-vivo (1), clipping with wrapping (2), clipping under cardiac standeart (3), trapping (1), trapping with bypass (4), and intra-vascular coil embolization (4).

Complications included intaroperative rupture (3), perforator injury (1), cerebral edema (1), transient hemiparesis (5, 2 secondary to failure), transient cranial nerve palsy (2), permanent cranial nerve palsy (1 secondary to failure), and vasospasm (1). Outcome was excellent in 6 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 potenially be the initial consideration for giant aneurysms involving the parent carotid artery.

13 Endovascular Management of Pediatric Lesions

AUTHORS: Indro Chokkuburi, MD, Arus P. Aman, MD (Los Angeles, CA), Michael L. Levy, MD (Los Angeles, CA), Don Larsen, MD (Los Angeles, CA), J. Gordon McClure, MD (Los Angeles, CA), George P. Tsaitihamb-M, 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, age 4.3). Follow-up ranged from 6-60 months. Endovascular treatments were performed on 61 vascular malformations (16 cerebral AVMs, 3 facial AVMs, 4 spinal AVMs, 6 dural AVMs, 2 CCF, 15 vascular neoplasms (e.g. juvenile angioblastoma, 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.
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in 1 (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. These patients developed new sacrococcygeal defects (hemorrhages and/or visual field loss). One patient underwent chiroanatomy for removal of residual AVN after a hemorrhage. There were no deaths. Conclusions: The obliteration rate reported here is lower compared to previously published rates for adult AVMs by radiotherapy. The permanent complication rate is low and should encourage those treating children to use the same doses as for adults.

AUTHORS: Sebastian Thomas, Cordula Matthies, MD (Hanover, Germany), Katja Erneis, MD (Hanover, Germany), Marco Tatagiba, MD (Hanover, Germany), Madjid Samii, MD (Hanover, Germany)

Abstract: Objective: Neurinoblastoma Type-2 (NF-2) is a rare genetic disease occurring with an unusual incidence of approximately 1:35,000. The prognosis regarding life quality is particularly 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. Of 62 patients repeated MRI-scans were obtained and growth rate of 93 unoperated vestibular schwannomas was determined. Therefore, the maximum diameter in all 3 dimensions (AP: anterior-posterior; ML: medial-lateral; CC: craniocaudal) was measured and tumor volume was calculated using following formula: Volume = 4/3*π*AP*ML*CC.

Results: The observation period ranged from 5-119 months. The overall growth rate was 2.92 ± 0.72 cm/yr. The correlation between age of illness onset and tumor growth rate is as follows: 5-19 years: 2.41 ± 0.56 cm/yr (N=59); 20-29 years: 1.31 ± 1.71 cm/yr (N=24); 20-39 years: 4.36 ± 2.17 cm/yr (N=9); 40-49 years: 0.09 ± 0.17 cm/yr (N=2).

Conclusions: In patients with early onset of Neurinoblastoma 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. Hahn, MD, Paul G. Fisher, MD (Stanford, CA), Quynh Le, MD (Stanford, CA), William Wara, MD (San Francisco, CA), Kathleen Lamber (San Francisco, CA), Bhinda Zadub, MD (San Francisco, CA), Theresa Goodwin (Stanford, CA), Michael T. Pender (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 medulloblastomas for two institutions were analyzed.

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

Results: Ninety-seven children (97; 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 extra-primary progression, and 29 with extra-primary failure only. Salvage therapy generally consisted of a multimodal approach. One-year, two-year, and five-year overall survivals from relapse were 47.8% (SE=1.5%), 32.2% (SE=4.8%), and 12.3% (SE=6.0%), respectively. There was a trend toward improved survival in those children who had received radiotherapy as part of the initial adjuvant treatment (p<0.1).

Conclusions: Younger age was associated with earlier relapse. Salvage therapy for medulloblastomas 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. Radiotherapy at initial treatment for medulloblastomas may exert a protective effect in improving survival after progression.

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

AUTHORS: Inade Chukwuebuka, MD, Suso Chui, MD (Los Angeles, CA), Michael L. Levy, MD (Los Angeles, CA), Floyd H. Gillis, MD (Los Angeles, CA), J. Gordon McComb, MD (Los Angeles, CA)

Abstract: A rare variant of glioblastomas, giant cell glioblastomas is characterized by bizarre multi-mutated giant cells which dominate the tumor histology. Few reports have studied this subtype of glioblastomas, 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 two through nineteen had variable clinical presentations including alterations of consciousness, mental nerve, palsy, seizures, and long tract findings. Fourteen tumors were supratentorial and four were infratentorial. Tumors were treated with biopsy only (31%), biopsy with chemotherapy and/or radiation (21%), partial resection only (31%), partial resection with adjuvant therapy (10%), or total resection followed with adjuvant therapy (21%). Survival took place between dates of the 1940s and 1980s. At surgery specimen includes cystic components, firm, friable, yellow-to-color, vascular, soft, and infiltrative were often used. Characteristic histologic were seen in all tumors. Survival times ranged from a few days to 10 years. Mean survival was 1.9 years, however, there was a 4 year and a 19.5 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 indicates while there are some isolated cases of longer survival, mean survival for giant-cell glioblastomas is only slightly longer than glioblastomas.

19 Pediatric Ependymoma (40 in 36 months)

AUTHORS: Benetta J. Oสะดวกร, MD, Robert A. Sutro, MD (Memphis, TN), Thomas E. Marchant, DO, PhD (Memphis, TN)

Abstract: At this point in time the proven prognostic factors for spina bifida are extent of disease (localized), extent of resection (gross total), and adequate radiation therapy (cisplatin at 50 Gy). In the past few years, combined-modality therapy for supratentorial ependymoma is advocated. Historically, complete resection and postoperative radiation therapy confer an 80% 5-year progression-free survival; compared to 39% in children with incoexistent 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 82% gross total resection. Eight children presented untreated and in 8 a complete resection was obtained. Patients were referred after complete resection for conformal (focused) radiation to be delivered in a protocol setting. Sixteen were treated with residual disease after an unsuccessful attempt at gross total resection (all posterior fossa). Twelve were reoperative and a gross total resection was achieved in 10; 2 had residual tumor measuring less than 1 cm. These 24 children (65%) demonstrated the feasibility of obtaining gross total resection in 80.90% of
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children with ependymomas. Following this pilot study, the methodology used to increase the rate of gross total resection for ependymomas 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 quadriplanar vision (2 neurosurgeons) used to achieve these results will be detailed.

AUTHORS: Jean-Pierre Farmer, MD, CM, FRCSI(C), José Luiz Monteiro (Montreal, Quebec, Canada), Carol R. Frooman (Montreal, Quebec, Canada), Mazen C. Braid (Montreal, Quebec, Canada), Frédéric Mouhas/Vilmunro (Lausanne, Switzerland), Augustin M. O’Turman (Montreal, Quebec, Canada)

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

A non-pontine brainstem location, a cystic or ependymal component, enhancement with gadolinium injection, a histological diagnosis of pilocytic astrocytomas or gangliogliomas 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 pens”. The relative impact of radical surgery and/or radiotherapy is analyzed. Surgery coupled to adjuvant such as navigation, ultrasound and monitoring plays an important role for non “black pens” brainstem lesions - focal/conformal radiotherapy has an adjuvant role. Patients treated with radiotherapy first followed by surgery have equal survival, but higher morbidity.

AUTHORS: George J. Julio, MD, Danna 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 pined region, third ventricle, brainstem and hypothalamic were excluded. We had 33 children, mean age 10.3 years, with a broad spectrum of 42.4 months (range, 1.1 to 13.2 years). The presenting symptoms were raised intracranial pressure (13.6%) children, or motor deficit (13.5%). The mean proctome was 57 days. The neoplasm was in the left thalamus in 15 cases, right in 6 and bilateral in 2 cases. A biopsy, endoscopic or stereotactic, was performed for 5 children, and a resection performed in the remaining 17 children. The surgical approach was transcallosal for 8 children and a transtorial transeptal approach for 9 children. Transient deficits occurred in 9 children (motor, hemiparesis, cranial nerves) and permanent deficit in 2 children. The histology included low grade astrocytomas 6, high grade astrocytomas 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 56% of high grade tumors are alive. The mean survival at 23 months. Conclusion: Thalamic tumors are rare neoplasms in children. The overall prognosis of children with tumors in this location is different from the histological diagnosis.

21 Management of Thalamic Tumors in Children

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

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

ABSTRACT: Diabetes insipidus (DI) is a common complication of craniofacial surgeries (CP) resection. It is not clear 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+) and occurrence of DI.

Methods: A retrospective chart review was conducted for patients having CP resections between the years 1986 and 2000. Charts were reviewed in duplicate and perioperative data were extracted (group to 65 hours postop). To examine fluctuations in Na+, the presurgical Na+ and the nadir and peak Na+ within the first 24 hours following surgery were recorded (in mmol/L).

Results: Total of 31 CP resections were performed in 20 patients over the 6 years (mean age 8.4±3.9 years); 17 of the 20 patients (85%) developed DI within the first 24 hours postsurgery 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 135±7, respectively. Na+ fluctuated by 19 mmol/L±8 over 24 hours. In 5 patients (18%), Na+ fell below 130 mmol/L, while in 11 (45%) it peaked at more than 150 mmol/L and in 4 (24%) more than 160 mmol/L.

In conclusion, patients treated with DDAVP prior to surgery had a lower occurrence of DI (14∥), with the 24 hour postsurgical nadir and peak being 136±4 and 140±4, respectively. The mean Na+ fluctuation across these patients was 12 mmol/L±5, with only 1 patient having a Na+ below 120 mmol/L, and above 150 mmol/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 Craniofacial Tumor: Long-term Follow-up Following Aggressive Surgical Resection

AUTHORS: Jeffrey P. Blount, MD, Flavio Pol de, MD, Cynthia Cupido, MD, Patricia Rowe, RN, Tina Popek, RN, CPNP, H. J. Hoffman, MD (Toronto, Ontario, Canada), R. P. Humphreys, MD (Toronto, Ontario, Canada), J. T. Rocka, MD (Toronto, Ontario, Canada), P. B. Dirckx, MD (Toronto, Ontario, Canada), J. D. Drake, MD (Toronto, Ontario, Canada)

ABSTRACT: Background/Objective: The optimal treatment of pediatric craniofacial malignant tumors is controversial. Aggressive surgical resection has been advocated in 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 craniofacial tumors during the MCI era (1986-2000) were reviewed. Data included age at resection, previous surgery, site and imaging characteristics of tumor, surgical approach, intra and postoperative complications, postoperative imaging, recurrence and length of follow up.

Results: 73 patients underwent 107 operations. A subtotal/partial removal was used in 77 cases while 14 underwent an adjuvant craniotomy. 18 others underwent another operative approach. Of 21 patients with follow up greater than 5 years, 175±2 (54%) demonstrated no recurrence following gross total resection (surgeon impression) while 143±1 (48%) required further surgery for recurrence. Average time to recurrence for resected lesions was 840 days. All subtotally resected tumors followed more than 190 days recurred. Acute complications during the initial hospitalization
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24 Aprotinin: A Pharmacologic Therapy that Reduces Blood Loss in Craniofacial Surgery

AUTHORS: Karin M. Muraseho, MD, Steven R. Buchman, MD, Hamish M. Munro, MD, Laurie J. Bierieke, MD (Ann Arbor, MD)

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 (4 mg) test dose of Aprotinin, which, if negative, was followed by a loading dose of 240 µg/m² and a continuous infusion of 50 µg/m²/hr for the duration of surgery. For comparison, a control group (Group B) 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 < 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 blood products at all compared to control groups.

Conclusions: 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, Miream Talsoos, MD (San Antonio, TX), Patricia Mancuso, MD (San Antonio, TX), Dennis Vollmar, MD (San Antonio, TX), Nitis Torden, 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 bitemporal region 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 the appropriate bone flap(s) was turned. The multiple revolution spiral osteotomy was completed. Elevation of the bone 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 2.9-9 months). The follow up results of this procedure includes 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-osseosification rate. This procedure allows for cranial remodeling, bone bridging, and re-osseosification 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 Cranietomy for Sagittal Craniosynostosis: A Retrospective Review

AUTHORS: Donna T. Tyler IL, 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 lambds and bregma. The endoscope was used to assist with the subgaleal and extradural bone dissection. The placement of a postoperative 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 that of the open technique. The mean operative time was nearly 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 A/P lateral skull ratio rates were nearly even. We conclude that this endoscopically assisted method is associated with a lower blood loss, and similar follow up A/P lateral skull ratios without additional operative time.

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

AUTHORS: Paul C. Finnell, MD, PhD, Jayesh Panchal, MD (Dept of Plastic Surgery, Oklahoma City, OK), J. L. Marsh, MD (Chicago, IL), T. S. Park, MD (Chicago, IL), W. Kienman, MD (San Antonio, TX), T. P. Pilgram, PhD (Chicago, IL), B. Hosking, MD (San Antonio, TX)

ABSTRACT: 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 12 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 calvarvectomy 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 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=0.16). Twelve patients underwent subtotal calvarvectomy (mean age 5.2 months). Their mean CI preoperatively was 86 versus 74 at 1 year postoperatively (p<0.0001). The percentage improvement in CI 1 year after subtotal calvarvectomy was greater than that after extended strip craniectomy (p=0.003).
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28 Cortical Dystrophy
in Non-Syndromic Craniosynostosis

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 isometric, 2 lambdoidal, 1 squamous, all fusing laminae in horizontal and multiple oblique directions and were evaluated without clinical data. All patients had a full neurosurgical evaluation, including head CT or MRI, and cranial ultrasound. The surface-rendered images were displayed in orthogonal and coronal planes.

Results: In addition to the expected deformity of the skull and brain, the following findings were noted: (a) sagittal - verticalized sylvian fissure; obliquely oriented central sulci, hypoplastic frontal lobes, and compressed parieto-occipital cortex; (b) coronal - compressed, hypoplastic frontal lobes, vertically oriented sylvian fissure, anteriorly placed central sulci, abnormal gyri, and small prefrontal gyri; (c) bilateral - compressed bilateral frontal cortex, hypoplastic parietal lobes, and enlarged precentral sulci; (d) isometric - hypoplastic frontal lobes and asymmetric hemispheres; (e) lambdoidal - compressed cisterns, and abnormal small gyri homolaterally; (f) squamous - compressed cortex.

Conclusion: 3D surface renderings demonstrated unique topographic appearances. In addition to the mechanical compression of the brain beneath the calvarial deformity, 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. Feasal, MD, PhD, Hamid Amirebehzadi, MD (Oklahoma City, OK), Robin Gorwich, PhD (Oklahoma City, OK), Vicki Cook, MD (Oklahoma City, OK), Jayesh Faujhal, MD (Oklahoma City, OK), Barbara News, 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 data from the scores was divided into four groups: accelerated, normal, mild delay and significant delay. The distributions of the Motor Developmental Index (MDI) and Psychomotor Developmental Index (PDI) were then compared to a "typical" age-matched population using Fisher's exact chi-square test.

30 Surveillance CT Scans in Routine Shunt Evaluation

AUTHORS: Sonet W. Elliott, MD, R. Shane Tubbs, MR, PA-C (Birmingham, AL), Paul A. Grubb, 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 "presumptive" 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 2000 to July 2000 in our clinic 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. Of these 8 (7%) were in children with myelodysplasia. Of the 8 (7%) who underwent elective revision within one week, the other 2 patients chose observation after careful discussion between the attending physician and the family. All 5 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, Intracranial Hypertension in Silt Ventricle Syndrome Patients with Shunt Malfunction

AUTHORS: William E. Butler, MD, Saud 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 straightforward 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 intracranially enlarged by the gradual, controlled application of intracranial hypertension via an external ventricular drain (EVD).
32 Infection Rates in the Treatment of Loculated Hydrocephalus with Endoscopic Fenestration

AUTHORS: Renatta J. Osterdock, MD, Stephanie L. Eihana, MD, Michael Mullhasser, MD, Frederick Hoop, MD, Robert A. Stanford, 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 60 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 60 patients with an average of 3.5 per patient (range 1-14). Thirty-nine procedures were performed with the endoscope and 135 without the endoscope. Diagnoses included IVH of prematurity (25, 4 with meningitis), congenital hydrocephalus (17), tumors (5), brain abscess (4), post-infectious (5), Dandy-Walker (3), other (6). There were two deaths during the study period due to unrelated causes. Infection rates were closely reviewed. A total of 6 infections occurred. Four were in the endoscopic group (6.9%) and 4 in the non-endoscopic group (8.8%). Our institutional infection rate 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 L. Hadar, MD, FRCSC, Jim Donald (Vancouver, BC), John Keeler (Salt Lake City, UT), Owen Szafron (England)

ABSTRACT: Delayed failure following successful third ventriculostomy (TV) for obstructive hydrocephalus is rare. Death as a consequence of a failure of 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 Southampton 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 12 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 3 years postoperatively to an emergency with symptoms of increased ICP. The symptoms were dissipated 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.

Conclusions: All of our patients 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 in the midbrain should be treated with TV. In experienced hands this is an effective and durable treatment with very low morbidity for this select patient population.

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

AUTHORS: Curtiss J. Rozelle, 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 gliomas 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 corona bur 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: Retan R. Bulsara, MD, Thomas J. Cummings, MD (Durham, NC), Roger E. McLendon, MD (Durham, NC), Herbert E. Fuchs, MD (Durham, NC), Timothy M. Georpi, 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 than compared this staining pattern to filum associated with tethering or spinal dysraphism.

Methods: Control films 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 films were confirmed histologically and
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36 The Relationship of Malformation Anatomy to Deterioration Patterns in Patients with Transitional Lipomyelomeningocele

AUTHORS: David D. Cychotka, MD FRCS(c), Christian Flucke, MD, John Kestle, MD (Shah Lake City, UT), Paul Steinbok, MBBS (Vancouver, British Columbia, Canada)

ABSTRACT: Objectives: 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 LAVMC 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: 85% 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 21 patients and lateral malformations in 26. Prior to untethering, if symptomatic, and at the time of deterioration, patients with central malformations tended to exhibit spinal deficits and those with lateral lesions, asymmetrical, unilateral deficits usually on the side of initialisation.

The 90%ile time to deterioration in patients with lateral malformations was approximately 30 months and 60 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, orthopedic 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 neurological signs and symptoms while those with lateralised malformations deteriorate with ipsilateral signs and symptoms.

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

AUTHORS: David Hart, MD, Hulda Magnadottir, MD (Lebanon, NH), Mark Krieger, MD (New York, NY), J. Gordon McCubbin, 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 5 males (mean age at presentation 76.4 + 4.5 yrs). Seven had fatty filums and 2 had lipomeningocele malformations. Split cord malformations were thoracic (1), lumbar (1), thoracolumbar (1), and multilevel (8). No patients had associated Chiari I malformations or hydrocephalus. Mean follow-up was 5 + 2.7 years.

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

AUTHORS: Andrew S. Yekulis, MD, Hong Jin Suh, MD (Ann Arbor, MI), Harry Koo, MD (Ann Arbor, MI), David A. Bloom, MD (Ann Arbor, MI), Kirin Murakako, MD (Ann Arbor, MI)

ABSTRACT: Urodynamic dysfunction is common in patients with Tethered Cord Syndrome (TCS). In order to determine whether early untethering can prevent the development of urodynamic symptoms, we retrospectively reviewed urodynamic records of 82 children with TCS who underwent spinal cord untethering from February 1990 to March 1998. Each patient was evaluated with pre and postoperative cystometric studies (CMS), cystourethrogram (VCUG) and serial ultrasonograms (US). 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 myelomeningocele repair (Group II). In Group I the majority of patients presented with flat presacral CMG, absence of reflux on VCUG and no evidence of hydrocephalus on US. Postoperative urodynamic revealed stable filling patterns without progression on CMG in all but two patients. There was evidence of benefit with improvement of reflux in all four patients and improved hydrocephalus in three of five cases. There was only one case of worsening bladder compliance. In Group II, presacral CMG, VCUG and Renal Ultrasound showed abnormalities in 80%, 80% and 47% of our series. There was improvement in 75% of Group II patients with abnormal preoperative CMG. Urodynamic reflux and hydrocephalus did not appear to improve postoperatively. This study further provides evidence that early untethering in patients with TCS is safe and effective at preventing urodynamic worsening. It clarifies that our ability to prevent urodynamic symptoms continues to be better than our ability to reverse urodynamic abnormalities once already present.

39 The Natural History of Tethered Cord in Patients with Myelomeningocele

AUTHORS: lei K. Phuong, MD, Casey Raffield, MD (Rochester, MN), Kimberly Scheer, RN (Rochester, MN)

ABSTRACT: Objectives: 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 65 patients who had myelomeningocele repaired and later underwent orthopedic correction of spinal 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
40 Reliability of Intraoperative Electrophysiological Monitoring in Selective Posterior Rhizotomy

Authors: Sundeepr Mital, MD, Jean-Pierre Fauver, 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 roots. 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 SO-5 Hz train. A second stimulation run of the entire dorsal root was carried out prior to decision of the root into 3 or 7 modules. Rootlets were individually stimulated and recorded 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 6 as described by Phillips and Park. Grade differences between the first and second stimulation trains for the two sets were 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.

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

Authors: Shabbir Daniah, BS, Susan Guzzardo, PT (New York, NY), Linda Weissman, MS (New York, NY), P.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 children 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 (patient's average score divided by score age matched controls) 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 months (range 5-210). The mean preoperative functional quotient was 0.57 (range 0.15-1.2); the mean at age 10 was 0.67 (range 0.47-1.0); and the mean at follow up was 0.87 (range 0.15-1.0). 9/42 patients experienced either no change or worsening. 5 of these had little or no locomotory ability. 9 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 walked but did not walk preoperatively. None of the 42 children experienced worsening in spasticity 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 pathology.

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, Mariam 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 patient's tone and improvements in the quality of life in the patient's toe pain. 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 360 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 25 procedures done on the patients that required operative revision. Two patients required two 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 CSRF 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 prospectively with this data is important, and we discuss techniques that we have devised for minimizing complications.
Scientific Oral Abstracts

43 Subfascial Implantation of Intrathecal Baclofen Pumps in Children

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

ABSTRACT: Objective: Subcutaneous 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 underutilized 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 subfascial 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 those ages.

Results: No infection or skin breakdown occurred at the pump surgical site at an average follow-up of 18.7 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. Diao, 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, our 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 7 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. These four, 8,128 affidavets 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 overall 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 program’s 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 infant’s birth can significantly reduce SBS.

45 NonAccidental Pediatric Head Trauma: Diffusion Weighted MRI Findings

AUTHORS: Daniel Y. Ih, MD, PhD, Patricia Davis, MD (Atlanta, GA), Kara Hopkins, MD (Atlanta, GA), Nancy Fujima, 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 supraperiosteal 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-eight children were enrolled: 18 children with confirmed NAHT and 10 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 ADC imaging provided better delineation of the extent of white matter injury that was not well-visualized on conventional MRI. DWI/ADC abnormalities in the NAHT children had a high predictability to develop the most severe aspects of the cerebral hemispheres (88%) with relative sparing of the frontal or temporal lobes.

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. Diao, 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 15 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 40%. 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 report 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 acquired by families.
Scientific Oral Abstracts

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

AUTHORS: Waltraud Kleinhans-Welch-Guern, MD, Michael R. Gahb, 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 operative hemorrhages still presents an insurmountable 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 dural enlargement covered with temporal muscle fascia.

Results: The outcome, especially in children was surprisingly good. Only 3 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 GC5 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 paradigm, in/near the site of injury.

Methods: Case was provided to 83 injured skier children (age 3-18) at an Alpine Hospital. Data collected included ski 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 craniectomy; 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 severe 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 skier, 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 graphically clear when observations are made at the ski areas. Neuroradiographic presence at alpine competitive skis may rehash child skier mortality and morbidity. Locating child ski competition near such resource may be a factor to consider.

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

AUTHORS: Mei Wong, MD, Mark S. Doss, MD, FAAP (Buffalo, NY, Vostal 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 sensory deficits with (E) or without (F) MRI abnormalities; transient objective motor deficits with (G) or without (H) MRI abnormalities; and transient subjective sensory 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 (2%) (respondents), B (5%), C (0%), D (2%), E (7%), F (21%), G (28%), H (16%), I (16%), J (28%). Hospitalization was recommended most frequently in scenario A (100% of respondents), 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 d (19%). The duration of immobilization ranged from 9 to 56 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 the definitions 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 Tallio, MD (Philadelphia, PA), John Bookvar, 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 abnormalities 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 flexionextension 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 13.3 ± 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 ± 36.5 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.

Conclusions: 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 Daru, MD, Vertei 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 1981-1989. 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-tesla magnet.

Results: Neurological syndromes on presentation were either complete (Frankel grade A, 9.5%), severe, partial (Frankel grade C, 4.3%), or mild, partial (Frankel grade D, 86.9%). The majority of partial neurological deficits (72.91%) resolved within 72 hours; in 4 patients (17.8%), 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 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 transitory 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 Le, MD (Saskatoon, Canada), Peter Dicks, MD (Toronto, Ontario, Canada), James Drake, MD (Toronto, Ontario, Canada), Douglas Hedy, 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 instability, 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 Somogy as type 1B transverse ligament injuries (Neurosurgery 34:4, 1990) and operative treatment has been required because of symptoms 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 surgically, 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. Durbin, MD, John Boodhawan, 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) of 0.8 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: 23 children (9 male, 4 female) presented with transient neurologic deficits following a sports-related cervical spinal cord injury. Ages ranged from 7 to 18 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 popsticking (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 three 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 Fryborg, MD, Yong Pack, MD (Kyungbuk, South Korea), Jack Yu, MD, John Vander, MD (Murrieta, GA), Mark Lee, MD, PhD (Augusta, GA)

ABSTRACT: Five patients between 8 and 14 years of age underwent invasive monitoring with cortical and 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-patterns, before, during and after a seizure. Commonly a rapid ICP spike is seen at the onset of the majority of all seizures. These peaks last for 10-20 seconds and are seen right at the onset of EEG-abnormalities or may precede them by 5-15 seconds. The ICP returns 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 patterns of the ICP-tracing at seizure time suggest 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 algorithms 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 Rasmussen's Disease

AUTHORS: Alan T. Villavicencio, MD, Michael Hughen, MD, PhD (Durham, NC), Dary Lewis, MD, (Durham, NC), Rodney Rhotie, MD (Durham, NC), Richard Morey, MD (Durham, NC), Ketan Bhalera, MD (Durham, NC), Timothy M. George, MD (Durham, NC)

ABSTRACT:
Introduction: Many surgeons have been reluctant to perform surgery and continue failed medical therapy in older children with Rasmussen's disease due to the risk of spasticity and other neurologic function. The authors describe three older children with Rasmussen's disease and medically intractable seizures who underwent successful hemispherectomy.

Clinical Data: Mean age at diagnosis was 10, 16 and 19 years old. All patients underwent the standard four phases of presurgical epilepsy evaluation. Two of three patients had biopsy-confirmed Rasmussen's prior to hemispherectomy.

Results: Follow-up ranged from 24 to 60 months (mean, 30 months). Three patients received serial EEGs and seizure diaries. Two patients had significant improvement in their presurgical epilepsy severity. The 15-year-old patient had stable epilepsy in the postoperative period with no significant improvement. Following surgery, all three patients were left with some residual contralateral hemiparesis, but had improved overall functional outcomes.

Conclusions: This study supports the aggressive surgical approach in older children with Rasmussen's disease. Although focal deficits such as hemiparesis and visual field defects are seen, patients and families have improved overall outcomes. Hemispherectomy may 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. Vitan, MD, Thomas Mortarty, MD, PhD (Louisville, KY), Stephen Huftek, 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 surgeon's 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 (1 recurrent tumor). Two of these patients underwent frameless MRI-guided stereotactic biopsy for histological confirmation prior to their resections. Three patients underwent stereotactic catheter placement into tumor-related cysts (2-cystic craniopharyngiomas, 1 hypothalamic hamartomas). Two patients underwent direct anterior micro-instrumentation for resection of intracranial masses, and another two patients underwent removal of posterior cranial masses. The final patient underwent MRI-guided open biopsy of a left perisylvian lesion. There were no infections, hemorrhagic or neurological complications. Gross total tumor removal was obtained both by visual inspection and MRI imaging in 9 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, aid in tumor and spine and reduces the maximal possible tumor resection. It has also increased the awareness of minimally invasive microscopy 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. Wallas, MD, J. C. Leveque, BA (Durham, NC), Matt McGirt, BA (Durham, NC), Jeffrey Pitrella, MD (Durham, NC), Jamee Voyeradi, PhD (Durham, NC), Herbert Fuchs, MD, Michael Hughen, MD, Timothy M. 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 presurgical planning tool in pediatric neurosurgical patients scheduled to undergo resection for brain tumors.

Methods: Two subjects underwent fMRI scanning on a GE 1.5T magnet while performing fine motor or language tasks. Intraoperative motor mapping took place during surgical intervention and preoperative 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. Postoperative imaging revealed satisfactory tumor resection. The incidence of postoperative neurologic deficit did not increase.

Conclusions: Real-time fMRI brain mapping is a valuable noninvasive aid in presurgical pediatric brain tumor resection planning by producing reliable activation maps utilizing a single 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.
Scientific Posters

1 Experimental Cortical Dysplasia: Histological and Physiological Analysis

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

ABSTRACT: Introduction: Cortical dysplasia is 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 kainic acid (KA) on embryonic day 15. Rat pups were perfused and their brains processed for histology on postnatal days 0-50. 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 kainic acid produces rat pups with cortical dysplasia which has features similar to that found in human dysplastic cortex. These features include subcortical and periventricular heterotopias, disruption of the normal cortical laminae, and hyperoxic neurons. Under conditions of partial GABA receptor blockade, neurons 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. Locastor, MD, PhD; Tari Fukuhara, MD; Raner Elhoub, MD

ABSTRACT: Introduction: Dural closure methods for Chiari decompression remain controversial. We review our experience with 35 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 1st lumbar puncture. The dura was not opened in 5 cases. Twenty-three patients underwent a watertight closure using cadaveric dura/fascia (n=12), Gore-Tex (n=8), occipital petroclival autograft (n=5) or Alloderm (n=1). In 5 cases the dura was left open, overlaying the defect with DuraGene bovine Achilles tendons, n=10, and gel foam only (n=2).

Results: Only one patient required a re-thoracic decompression for persistent symptomatic syndromas and no patient required re-operation for complications. Post-operative complications included 2 CSF leaks (6%). The first leak occurred after cadaveric dura closure and required a resecting only. The second leak occurred after an open dural defect with Duraplasty overlay and included pseudomeningocele and infection and required intravenous and bacteria. The overall rate of pseudomeningocele was 15% although there was a CSF collection transient with a median of 9 months for resolution and each occurred 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: Barmann J. Ikskinder, MD; Akin Dugan, 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 outcomes 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 intrathecal pressure.

Methods and Results: We present our intraoperative and postoperative observations in 8 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 outcomes 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 Prueckner, MD; Jonathan Jagod, MD (Miami, FL); Dorene Beguiristain, RN (Miami, FL); John Raghib, MD (Miami, FL)

ABSTRACT: Children with sickle cell disease (sickle cell 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 1980 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 9.0. All patients with Hgb less than or equal to 7.1 (49) had negative CT scan 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 (5) was inconclusive. Patients were treated with analgesics, oxygen and hydration. Three of these patients underwent single volume exchange transfusion on admission or prior to angiography such that median 63%Hgb S was 22.5 and median Hgb 9.25. 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.
Scientific Posters

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

AUTHORS: Nicholas C. Bambaideh, 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 Children’s 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 patient. 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. Intensive care units grew anaerobic organisms in one patient, microaerophilic streptococci in five patients, Bifidobacteria 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 deficit characterized by varying degrees of hemiparesis, obtundation, papillary dilation, or aphasia. All patients underwent craniectomy and evacuation of the intracranial infection. Even severely impaired patients demonstrated full neurologic recovery.

Conclusion: Despite 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.

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

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

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 fibromas and infantile fibrosarcoma (dissecting 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 infantile fibromas. 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 fibrosarcoma. 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 fibromas behave 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.

8 Prognostic Heterogeneity of Intracranial Juvenile Pilocytic Astrocytomas

AUTHORS: Philip C. Aldana, MD, Cheopillal Ramanathan, PhD, Steve Melnick, MD, Andrew Joo, MD, P. Shalhav and Anna Borel, MD, John Baguley, 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 multiformity. Furthermore, those with aggressive behavioral show varying responses to chemotherapy. To understand their behavior, we prospectively studied fourteen tumors that exhibited a spectrum of proliferative behavior prior to their resection.

Methods: In addition to histopathological analysis, all tumors were studied immuno-histochemically using markers for cell proliferation (Ki67 and PCNA) and apoptosis (Bax, Bel-2, p53, p21). RT-PCR assays were used to detect resistance genes (MRD1, MRP, LRP and DBP) to chemotherapeutic drugs.

Results: Pathology included juvenile pilocytic astrocytomas (n=7), low grade fibrillary astrocytomas (n=4) and subependymal giant cell astrocytomas (n=3). 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 multiformity on preoperative imaging. The infiltrative fibrillary astrocytomas expressed Ki67, PCNA, p21, p27, Bax, MDR1 and LRP genes as compared to low levels of p21 expression in non-infiltrative low grade tumors. The newly closed drug resistance marker, DBP, was co-expressed in 4/7 of pilocytic astrocytomas along with other markers (MRD1, MRP or LRP).

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

AUTHORS: Bennet J. M. Pirrote, MD, Alphonse Lobanou, MD, Philippe David, MD, Catherine Christophe, MD, Eric Surban, MD, Maurice Liptay, MD, Jacques Borel, MD, PhD

9 Intermittent Pilocytic Astrocytomas (IPA) are histologically defined as grade 1 tumours and present as incidental or slowly growing neoplasms. Secondary malignancy/worsening have been exceptionally rare, 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 or TR 12, partial PR 9, biopsy 7) to chemotheraphy/radiation therapy or radiotherapy. We retrospectively assessed symptoms, diagnostic presentation on magnetic resonance (MRI) and postoperative outcome (follow-up, survival month) tumour progression (TP), secondary latency/malignancy.

Results: All IPA appeared well-delineated lesions on MR (gliodini-um-enhancement) in 26, Postoperative outcome was excellent (6-12 months) in 21 children (11 without recurrence after TR, 10 with 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 post PR/biopsy death after decompression confirming the remaining grade 1 histology. No correlation was found between histology and outcome.
9 Epigenetic Regulation of Gene Expression in a Human Medulloblastoma Cell Line Using cDNA Arrays

AUTHORS: Alex Mohit, MD, PhD, Gregory Foltz, MD, Gerald Graunt, MD, Lorna 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 medulloblastomas, T9E71, an established medulloblastoma cell line was treated with 5-azacytidine and Trichostatin A (a histone deacetylase HDAC) inhibitor in culture. Alterations in gene expression were studied using cDNA microarrays involving 7682 genes. Of these, 550 were differentially expressed (668 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 Dusp4 (a 16 fold upregulated), neurofilament 66.0 (fold upregulated) and SSCL-1 (a 11.4 fold protein expressed during cerebellar granule cell differentiation, 2 fold upregulated). Two DNA repair proteins, Rad50 and XRC1-1, were also upregulated. The final class of proteins identified included two complement proteins (chitinase and DAP) 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 Graunt, MD, Lorna Walker, Michael Bobola, PhD, Peter R. 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-aza-deoxycytidine, 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 glioblastomas.

METHODS: Pediatric (UW67) and adult (U87, T98) glioblastoma cell lines were sequentially treated for 24 hours with 2 μM 5-AzaC and 0.5 μM TSA. Fluorescently labelled cDNA probes derived from treated cells and DMSO-treated controls were cohybridized to a customised cDNA microarray containing 7682 genes. 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, laminin, galactosidase, zyxin, aquaporin, connective tissue growth factor (CTGF), β-PA, ICIP1 receptor and hikunin. 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.

11 Large Cell/Anaplastic Transformation of Medulloblastomas and Medullobyomas: Clinicopathologic and Genetic Evidence for Tumor Progression

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

ABSTRACT: Objective: Medulloblastomas is the most common malignant CNS neoplasm in children. A distinct variant designated large cell/anaplastic medulloblastomas is characterized by frequent CSF dissemination 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 immunohistopathologic criteria for large cell/anaplastic medulloblastomas. 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 dsmplastic or chronic medulloblastomas were the underlying subtypes, and in 2 cases (26%), the large cell/anaplastic tumor was found to arise from medulloblastomas. Isochromosome 17q was found in five of six cases. Evidence of chromosomal gains suggested anaploidy 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 medullobyomas. As in conventional medulloblastomas, isochromosome 17q is a common early tumorigenic event. However, a significant percentage also have evidence of anaploidy and/or amplification of c-myc. These findings suggest that large cell/anaplastic morphology reflects a stage of advanced tumor progression in medulloblastomas and medullobyomas, not surprisingly associated with poor prognosis.
12 Synergistic Action of Genistein and Cisplatin on Growth Inhibition and Cytotoxicity of Human Medulloblastomas

AUTHORS: Hami Khoshnam, MD, Paul L. Moran, MD (Burlington, VT), Sean M. Lew, MD (Burlington, VT), Steven L. Wald, MD (Cincinnati, OH), Gregory C. Matsuda, BS (Burlington, VT)

ABSTRACT: Recent experimental data have shown that any inovators such as genistein significantly suppress the growth of many human malignancies. Here we examined whether genistein, at distant plasma levels, in combination with cisplatin exhibited additive or synergistic inhibitory effects on the growth of medulloblastomas cells. Human medulloblastomas cell lines (HTBR-186, MED-1, and CRL-8805) were treated with genistein at 60μM, the dietary plasma level in infants, combined with cisplatin (0-10μM). 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 (60μM) led to a 2.6-fold increase in monolayer growth inhibitory effect of cisplatin (0.65μM) in HTBR-186 cells (P=4.5x10^-6) by one-tailed t test and increased colony survival inhibition 3.6-fold (P<1.5x10^-6). Genistein with cisplatin (0.65μM) led to a 1.7-fold increase in monolayer growth inhibition and 2.4-fold increase in colony survival inhibition of MED-1 cells (P=3.5x10^-4 and P=1.1x10^-4 respectively). Genistein caused a 1.3-fold increase in antiproliferative effect of cisplatin (0.65μM) in CRL-8805 cells (P=3.1x10^-4) and enhanced the inhibition of colony survival 2.0-fold (P=1.22x10^-5). These effects were primarily synergistic. These results indicate that genistein at distant 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 chemotherapy 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 Vokonas, MD, Gregory W. Baitunshod, MD (Columbus, OH), Jerome Baslin, MD (Columbus, OH), Edward J. Konink, 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-acetylaseptate (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 Spectroscopy of twelve patients was obtained on a 3.5 Tesla GE scanner with a TR of 2000 and TE of 155. 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 0.8-3.5. Four of five (80%) of 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.

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

14 Intracranial Epidymomas in Children

AUTHORS: Benoit J. M. Piette, MD, Frank Van Calenberg, MD (Leuven, Belgium), Christian Plets, MD (Leuven, Belgium), Jacques Brechot, MD, PhD (Brussels, Belgium)

ABSTRACT: Objectives: Childhood intracranial epidiymas 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 epidymas, we decided to analyze the series from two centres in our country.

Materials and Methods: Thirty-eight children (21 infratentorial, 12 supratentorial) were identified (1960-1999) and retrospectively analysed 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 (9/12)). 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, 5 in stable disease, one in progression. 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 epidiymas. Cooperation between centers for retrospective analysis is finance and will lead to a prospective management protocol with specific recommendations concerning the place of shunt, the initial complete stage preoperative spinal magnetic resonance imaging and cerebrospinal fluid analysis, the quality of the surgical resection, the efficiency of adjuvant therapy and the role of surgery at relapse.

15 Supratentorial Oligodenrogliomas in Children and Adolescents

AUTHORS: Daniel C. Bowers, MD, Linda Margulief, Dallas, TX, Deborah L. Doexy, MD (Dallas, TX), Arljon F. Maine (Dallas, TX), Bradley Wepin, MD (Dallas, TX), Derek A. Bruce, MD (Dallas, TX)

ABSTRACT: Few reports describe supratentorial oligodenrogliomas in children and adolescents. Therefore, we reviewed our institution's experience with these tumors from 1985-2006, 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. 29 tumors were pure oligodenrogliomas (WHO grade II) and 3 were anaplastic oligodenrogliomas (WHO grade III). Tumor locations included the parietal (6 tumors), frontal (5), temporal (4), frontal/pial (3), parieto-temporal (4), 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 oligodenrogliomas were primarily treated with only aggressive surgery. 9 of 20 pure oligodenrogliomas were completely resected; of these, only 1 has recurred. Of 11 pure oligodenrogliomas that were subtotaly 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 oligodenrogliomas were treated with adjuvant chemotherapy and have subsequently recurred or progressed (progression-free interval: 3 mo-3.8 yr). KI-67/MIB1 immunohistochecmistry will be performed on tumor specimens and included in the presentation. Oligodenrogliomas are uncommon tumors during childhood. In our series, there was a non-significant trend supporting correlation of complete resection of pure oligodenrogliomas with improved progression-free survival. We do not recommend adjuvant therapy for substantially resected pure oligodenrogliomas. However, these patients need close follow-up for early detection of tumor recurrences.
16 Pediatric Dorsally Exophytic Brainstem Gliomas: Value of Aggressive Surgical Resection

AUTHORS: Renetta J. Gatterock, MD, Dwight E. Herron, MD (Memphis, TN), Richard L. Heideman, MD (Memphis, TN), Robert A. Sadee, MD (Memphis, TN), Larry E. Kuo, 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, 26 children with dorsally exophytic brainstem gliomas were treated at St. Jude Children’s Research Center and Leiden University Children’s Medical Center. Ages were 1.5 to 16.5 years (median 4.9), 11 male, 9 female. Median follow-up was 7.5 years. Pathology was juvenile pilocytic astrocytoma (15), fibrillary astrocytoma (4), and oligodendroglioma (4).

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 8 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 was 96±13%, and the overall survival was 89±10%. 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 87±16% vs 27±16% for sub-total resection. Freedom from progression following irradiation was 15% 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 brainstem 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 in 9 cases.

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. Piret, MD, Sacha Saldanha, MD (Brussels, Belgium), Patrick Van Beever, MD, PhD (Brussels, Belgium), Serge Goldman, MD, PhD (Brussels, Belgium), Delphine Lejeune, MD (Brussels, Belgium), Marc Levisse, MD, PhD (Brussels, Belgium), Jacques Brotchi, MD, PhD (Brussels, Belgium)

ABSTRACT: Objectives: Because brain tumors are histologically heterogeneous, stereotactic brain biopsies (SBB) may lead to inaccurate diagnosis and treatment. We developed a technique allowing precise integration of positron emission tomography (PET) data into the planning of SBB (Neurosurgery 51:792-797,1998). Combination of PET and magnetic resonance (MR) in the planning of SBB increased the technical's diagnostic yield in adults (J Neurosurg 82:445-452,1995). We report our preliminary experience applied in children.

Materials and Methods: Since 1994, 9 children (GM/AF, aged 2-14y) with infiltrative, ill-defined brain lesions (2 brainstem, 4 suprasellar-hippocampal, 2 pineal, 1 hypothalamic) were biopsied using combination of stereotactic PET/Fluorodeoxyglucose in 4, Fluorodeoxyglucose and Methionin in 2, Methionin in 1 MD, and MR. This technique was analysed in view of routine prospective application.

Results: This technique allowed to: obtain histologi diagonal in all patients; reduce the number of trajectories (1 brainstem and 2 pineal tumors); select targets in hypermetabolic areas (4 suprasellar-hippocampal tumors), allowing subsequently 2 PET-guided resections; exclude malignancy by guiding biopsy to hypometabolic area in a suprasellar lesion.

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. Schull, MDC (San Francisco, CA), Michael D. Dalin, BS (Palo, UT), Stephen J. Har, BS (Palo, UT)

ABSTRACT: Holograms from digital source images simultaneously 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-registration these two modalities together provide a methodically 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 followed the following innovations.

i) SNAP fiducial markers 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-examination 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 slice delineation. The comprehensive image information afforded by this technique helped to assist 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 Jolly, BS, Gregory D. Fritz, MD (Seattle, WA), Joseph R. Gross, MD (Seattle, WA), Richard G. Ellenberger, MD (Seattle, WA), Thaddeus S. Roberta, MD (Seattle, WA), Richard Winn, MD (Seattle, WA), John D. Loezer, 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 (6 male) aged 4 months to 19 years who underwent autogenous cranioplasty after decompressive craniectomy (17 left; 18 right; 5 bilateral) for varied causes (trauma 15, infection 11, tumor 11, or spontaneous ICH 19) from October 1987 to March 2000 (average follow up 4.8 years; range 4 months-15 years). The skull defect was predominantly frontal (56%) and/or parietal (43%). The defect surface area ranged from 14 to 147 cm2 (average 99 cm2). In all cases, the bone was compromised 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 < 0.05). No significant correlation was found with age, side or location of the skull defect, number of fractured bone fragments, presence of a dural, cause for decompressive craniectomy.
Scientific Posters

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

AUTHORS: Khalid A. Sehik, MD, Walter Low, PhD (Minneapolis, MN); Cornelius H. Lamb, MD (Minneapolis, MN)

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

Methods: A total of 66 perinatal rats, eight in each subgroup were utilized. Methyl-2-cyanoacrylate was applied across the sagittal, coronal and lambdoid 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 suture line. Age matched rats who underwent no procedures were included as normal controls. Serial brain sections were taken to chart calvarial growth and computerized tomography utilized to calculate mean calvarial volumes.

Results: At 30 days post-natal all rats were sacrificed, the brains fixed in situ, and a detailed morphological and cytoarchitectural analysis undertaken.

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

AUTHORS: Derek A. Togwed, MD, Arnold H. Musacchio, MD (Iowa City, IA)

ABSTRACT: Successful closure of a large cranial defect in the young child requires the cranialplasty 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 exist retention, with minimal morbidity at the donor site. Ilac crest, calvarium and fibula do not fulfill the requirements. The authors have utilized autologous rib grafts for cranial reconstruction and export their experience with pediatric cranialplasty.

Between 1998 and 2000 11 children, 8 months to 11 years, underwent rib graft cranialplasty. Mean follow-up from surgery was 27 months, with 10 subjects followed a minimum of 12 months. Etiology of the cranial defects were post-traumatic (3), growing skull fracture (5), previous encephalocele closure (2), reconstruction following tumor ressection (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 9).

22 The Surgical Correction of Metopic Synostosis

AUTHORS: Mark D. Krieger, MD, J. Gordon McCobb, 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 suprarnarial rims and produce hypotelorism. We retrospectively reviewed 30 cases of metopic synostosis treated over a 10 year period. This series included 26 males and 14 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 5 having synostoses of other sutures. Follow-up ranged from 1 month to 5 years, with an average of 19 months. Care was taken to observe the operative procedure to the nature of the deformity. In 3 mild cases,burghing of the metopic ridge was performed, with excellent cosmetic results in all cases. The other 30 patients had significant deformity of the supranarial ridges and temporal regions, with varying degrees of hypotelorism. In these cases, the patients underwent cranialplasty reconstruction to normalize their appearance. In addition, the lateral aspect of the supraorbital ridges, including the orbital roof and lateral orbital wall to the infratemporal fossa, 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.

AUTHORS: Michael Y. Wang, MD, John Armstrong, PhD, J. Gordon McCobb, 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 were fusion is critical. A polynumerated surfactant with physical characteristics similar to bonewax 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 tantalum plate was used to maintain long bone alignment. In the gap model no plating was used. Bonewax, surfactant, or filler alone 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, concomitance growth was seen in the site of Bonewax' implantation. In the nonunion model no fusion occurred in any group as expected. H & E staining showed development of an osteogenic callus at the gap site in controls and these with polymer. Rats implanted with Bonewax showed no new growth.

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

Scientific Posters

No donor or recipient site complications were noted. Ribs referred in 3 children who had surgery for 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.

Ribs grafts are an excellent bone source that fulfill the requirements for cranialplasty in a young child. They act as a noninvasive substrate upon which osteinductive and osteosynthetic bone extenders can enhance the effectiveness of the cranialplasty procedures.

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

Butfan salt polymer has physical haemostatic characteristics similar to Borvax® but does not inhibit bone growth. This may serve as an effective substitute for Borvax® in children to treat bone bleeding in sites where fusion is critical.

AUTHORS: Karren P. Fryszcz, MD, Jack Yu, MD, James Boker, PhD, Ann-Marie Pizzinato, MD (Augusta, GA)

ABSTRACT: Our current assumption is that cranial morphogenesis is a complex adaptive process with intrinsically 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 incomparable and wall tension would increase during the development of the nervous system unless the neurocranium expands. This series of experiments tests the hypothesis that mechanosensitivity occurs within the sutureal cells and addresses specifically the nature of tension-induced calcium flux.

Methods: 3 pairs of cranial 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 stress by 0.59 N of isotonic tensile force. The intrasutural calcium concentration was obtained with the emission ratio at 5030/510 nm. Other variables tested were: external calcium concentration, endothelial calcium stores, and plasma membrane calcium channels.

Results: 1. Changes in wall tension lead to immediate and reversible rise in intrasutural calcium ion concentration as reflected by increase of the emission ratio from 1.21 ± 0.002 to 1.26 ± 0.0064 (p = 0.0022). 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 CalATPase.

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

AUTHORS: Mark D. Krieger, MD, J. Gordon Mccomish, 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 unshaved shunt reservoir). A 23-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 pleocytosis 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 correlating data set was obtained from ventricular catheter reservoirs placed in 9 neonatal patients to treat hydrocephalus subsequent to perinatal meniscus hemorrhage over the same year. These reservoirs were tapped on average of 19 times each (range 4-43). 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.

25 The Safety of Tapping a Shunt

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

AUTHORS: Mark S. Giebel, MD, Aaron Kamnau (Pitts, UT); Kim H. Maunwaring, MD (Phoenix, AZ)

ABSTRACT: Introduction: Ventricularperforation (VP) shunts often fail when the proximal catheter becomes occluded with choroidal 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 drilling the catheter drainage holes in egg whites and microwaving the catheter briefly. Catheter obstruction was confirmed using an intracranial pressure microsensor (Codman Wire). A Codman Microendoscopic Electrode (MEE) was used to deliver monopolar directcurrent current to the tissue interiorized through the proximal catheter inlet hole. Once the holes were reperforated, 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 MEE 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 four trials, the steel stylet was unable to reopen the catheter. A risk of steel stylet penetration through the catheter inlet holes was also observed.

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

AUTHORS: William E. Whitehead, MD, MPH, John R. K. Wall, 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 staphylococcus, S. aureus, and GNR infections were 6-31 days (mean 15), 10-16 days (mean 15), and 14-26 days (mean 27), 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.

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

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

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28 The Surgical Management of Multiloculated Hydrocephalus

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

ABSTRACT: Multiloculated hydrocephalus, most commonly seen as a sequel of nonfatal 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 15-year experience with 30 cases of multiloculated hydrocephalus. Endoscopic 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 15 years (median age: 5.5 years). Each patient underwent a procedure for fenestration of septations, either via an open 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 concurrent 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 and effective means of managing multiloculated hydrocephalus.

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

AUTHORS: Anur Mohta, M Ch, Thimmappa Hegde (Bangalore, India), M. K. Vaudeev (Bangalore, India), S. Sarpande (Bangalore, India), S. Radhesh (Bangalore, India)

ABSTRACT: In Aqueductal stenosis (AS), endoscopic third ventriculostomy (ETV) is currently considered 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 prospectively. Staging 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, whereas patients with SSAS or AW were offered AP or AST. The breakup of the initial procedures is as follows: ETV: 8, ETV + AP: 2, AST: 3, AP: 2.

Results: During the follow up (6-12 months), of the 8 who had undergone ETV, 4 failed requiring subsequent shunt insertion. Of the 3 with AP, one patient had transient upper gaze palsy. There was no failure in the 7 patients who underwent AP or continued with AST.

Conclusions: 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 Rin, MD, Phoenix, AZ, Donna Wallner, RN, MS, CPNP (Phoenix, AZ), Geoffrey Zeleny, MD (Phoenix, AZ), Raymond Shamos, MD (Dept of Surgery) (Phoenix, AZ), Harold L. Bekete, 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 21-56) 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 adalialysis 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 endomycetoma the catheter was repositioned from an entrapped area of adhesions and sutured. The results of biopsy were uniformly negative.

Conclusions: Laparoscopic evaluation of distal VP shunt catheters is an inexpensive 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 Tyaagi, MD, Karl St. Berghozer, 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-op occipitaloccipitobasaldehnti (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 2.8, 1.53 and 3 times respectively for each valve type. Significantly, average shunt survival was 25.7 days, 16 days, and 37.4 days, whereas the average survival was 95.9, 34.5 and 138.8 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%, 25%, and 30%.

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 Ventricles Syndrome

AUTHORS: Sandeep Sood, MD, Raheel Barani, MD, PhD (Dartmouth, MI), Alphons I. Canady, MD (Dartmouth, MI), Steven D. Ham, D.O. (Dartmouth, 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 atypical 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 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 examined 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 ‘equivalence 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 PV1, 41 cc and mean drop in ICP on upright posture, 15 cc was noted. 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 'suring 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 itself 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 countering 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 Meavis, PhD, Julian Liu, MD (East Peoria, IL), Robert Hurt, PhD (Houston, TX), William Olivera, MD (Peoria, IL)

ABSTRACT: The objective of the study is to provide useful information about the fluid mechanics of shunt systems by using the test-bench and calculating flow-pressure relationships given the entrance and exit conditions. Using computer software, differential-pressure and any-pass preventing valves with different settings and sizes were tested. The software’s 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 higher 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 component 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. Hazelde, 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 meningocele to prevent recurrence. However, the detrimental effect of spinal cord tethering on scoliosis has been associated with an increase in fusion of the remaining 15, three patients required fusion 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 15 patients who avoided fusion 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: Sameer K. Elshara, 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 reave 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 (TB or SD) and orthopedic treatment under one anesthesia in order to reduce the number of general anesthetics 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. Method: All patients were screened in our multidisciplinary spasticity clinic and were candidates for selective dorsal rhizotomy (SDR) or intrathecal baclofen (ITB). Tibond releases variably included hamstring, toe, and adductor releases. Follow-up period ranged from 4 weeks to 3 years. Results: Age at surgery ranged from 4-14 years with a 16-9 male predominance. While spasticity response to SDR and ITB appears comparable, costs required by the releases impeded anesthesia 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 spastic at time release in some patients, one patient required cost removal secondary to severe pain. Conclusion: Tenon release performed in the same setting with either SDR or ITB may reduce surgical expenses and may ultimately result in good outcome. However, the multiple incisions and access required in tenon 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**

**AUTHORS:** George T. Burson, MD, T. Glenn Fait, MD (Little Rock, AR), Richard E. McCarthy, MD (Little Rock, AR), Osama Al-Mefty, MD (Little Rock, AR), Frederick A. Roop, MD (Memphis, TN), Resan A. Aristovich, MD (Little Rock, AR)

**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 skull), 2) inside-outside (placement of screws from inside through burr holes) with locknut securing the screws to cervical fixators. From 1995-2000, seventeen patients underwent inside-outside occipitocervical fusions, ages 3-17 years (9 girls, 7 boys). Indications for surgery included congenital anomalies, developmental instability, dysplasia, instability after osseous 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 halo. Patients followed 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 out 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 fashion; the flat surface of the screw head rests snug to dura, and diameters of screw heads can be increased, adding to pullout strength. 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**

**AUTHORS:** Daniel J. Curry, MD, David Wright, PhD, Raphael Lee, MD, Un Kang, MD, David Fras, MD (Chicago, IL)

**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.

Method: Twenty-nine Sprague Dawley rats underwent stereotactic injection of 129 nl of quinolinic acid into the striatum and subsequently received intracranial injection of vehicle or P188 (80mg/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). Intracranial surfactant, injected at both time points, reduced the number of animals showing evidence of tissue damage and necrosis to 22% (n=7). The timing of the injection also showed differential effects, with the 5 minute injection resulting in best 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 delineation of the neuroprotective effects of the molecule should help determine its potential clinical utility.

38 **Infant Homicide form Child Abuse in Los Angeles County**

**AUTHORS:** Michael Y. Wang, MD, Pamela Griffith, MSN (Nevada, IA), Anthony Kim, MD, J. Gordon McComb, MD (Los Angeles, CA), Michael L. Levit, MD (Los Angeles, CA)

**ABSTRACT:** Infant and childhood deaths from abuse are frequently due to head trauma. We reviewed data compiled by a multicounty 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 Compared.

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 (10%), suffocation (13%), and abdominal trauma (6%). 30% of these families had a history of domestic violence, and 30% 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, 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**

**AUTHORS:** Marjorie C. Wood, MD, Lori McBride, MD (Denver, CO), Robert E. Bruce, MD (Denver, CO)

**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 exam 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 trauma 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

**AUTHORS:** Jeffrey E. Catanzarite, MD, John Collins, MD? (Los Angeles, CA), Jeff Label MD, (Los Angeles, CA) Austin Cohaman, MD (Los Angeles, CA)

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

Data: Using a 1.5 mm MRI scanning system and a short echo MR spectroscopy (STEAM) voxel data was obtained. Using fast fourier transform of data sets, lactate, creatine (Cr), choline (Cho), N-acetylated (NAA) signals were measured as peak areas. A t-test using mean metabolite ratios (NAACr and NAA/Cho Cr/Cr) with good versus poor outcome.

Results: A positive correlation of poor outcome and high peak mean ratio 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 outcomes in pediatric head injury.

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

**AUTHORS:** William E. Butler, MD, Paul H. Chapman, MD (Boston, MA)

**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 Tomohon MD) that allows standard wall electrical outlets, has a translating gantry, and can be pushed from room to room. We coupled it to an image-guidance system (Radiology OTS) for online updating with intraoperative images.

Results: The scanner has proven most useful in our burl hole procedures where the margin of error is small. It was employed in four cases of isolated fourth ventriculocystosis. In those 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 burr hole procedures. In our current practice where the exposed pathology furnishes direct visual and tactile cues to the surgeon, intraoperative CT is of less value.
<table>
<thead>
<tr>
<th>Name</th>
<th>Institution</th>
<th>Address</th>
</tr>
</thead>
<tbody>
<tr>
<td>Edward C. Bencel, MD</td>
<td>Cleveland Clinic Fatih</td>
<td>9500 Euclid Ave, Dept 890, Cleveland, OH 44106-0091</td>
</tr>
<tr>
<td>Thomas S. Berger, MD</td>
<td>UCHSN/Neurosurgery</td>
<td>505 Parnassus, Box 0112, San Francisco, CA 94122-2722</td>
</tr>
<tr>
<td>Mitchell S. Berger, MD</td>
<td>Temple Univ.</td>
<td>5401 N. Broad St., Suite 658, Philadelphia, PA 19140-5163</td>
</tr>
<tr>
<td>Peter Mcl. Black, MD</td>
<td>Children's Hosp.</td>
<td>300 Longwood Ave., Boston, MA 02115-5724</td>
</tr>
<tr>
<td>Jeffrey P. Blount, MD</td>
<td>Gerad Street, West Ave. #2505</td>
<td>Toronto, ON Canada</td>
</tr>
<tr>
<td>John Scott Boggs, MD</td>
<td>1820 Barre St., Suite 104</td>
<td>Jacksonville, FL 32204-4742</td>
</tr>
<tr>
<td>Frederick A. Bop, MD</td>
<td>Semans-Murphy Clinic</td>
<td>229 S. Claybrook, #860, Memphis, TN 38104-3662</td>
</tr>
<tr>
<td>William R. Boydston, MD</td>
<td>5455 Meridian Mark Rd., Suite #540</td>
<td>Atlanta, GA 30342-1640</td>
</tr>
<tr>
<td>Bruce C. Breneler, MD</td>
<td>720 S. Van Buren</td>
<td>Green Bay, WI 54301-3538</td>
</tr>
<tr>
<td>Douglas L. Brodmeier, MD</td>
<td>100 Medical Dr., Suite 2400</td>
<td>Salt Lake City, UT 84113-1103</td>
</tr>
<tr>
<td>Michael J. Chaparro, MD</td>
<td>Neuropsych Inst. of Palm Beach</td>
<td>500 S. Congress Ave., #190, Atlanta, GA 30302</td>
</tr>
<tr>
<td>Paul H. Chapman, MD</td>
<td>Massachusetts Gen. Hosp.</td>
<td>55 Fruit St., GB2502, Boston, MA 02114-2621</td>
</tr>
<tr>
<td>William R. Cheek, MD</td>
<td>Houston, TX 77003-2343</td>
<td>Houston, TX 77003-2343</td>
</tr>
<tr>
<td>Maurice Choux, MD</td>
<td>Hopital Des Enfants</td>
<td>De La Timone, Cotes &amp; Marseilles, 33385 France</td>
</tr>
<tr>
<td>Samuel F. Criccell Jr., MD</td>
<td>5238 Fair Oaks Blvd.</td>
<td>Carmichael, CA 95608-5760</td>
</tr>
<tr>
<td>David Douglas Cochran, MD</td>
<td>1111 Michigan Ave., N.W.</td>
<td>Washington, DC 20010-2016</td>
</tr>
<tr>
<td>Philip Harry Cogan, MD</td>
<td>Children's Hosp.</td>
<td>219 Brent St., Buffalo, NY 14222-0006</td>
</tr>
<tr>
<td>John J. Collins, MD</td>
<td>7315 Llewellyn Dr.</td>
<td>Salt Lake City, UT 84109-1211</td>
</tr>
<tr>
<td>S. Michael Constantini, MD</td>
<td>Dana Children's Hosp.</td>
<td>6 Weissman St./Ped. Neurosurg. Tel Aviv, 64329 Israel</td>
</tr>
<tr>
<td>Richard A. Coulson Jr., MD</td>
<td>Ohio State Univ.</td>
<td>1531 Jerome Rd. New Orleans, LA 70112-2423</td>
</tr>
<tr>
<td>Jeffrey W. Cozzens, MD</td>
<td>Div. of Neurosurgery</td>
<td>2600 Ridge Ave. Evanston, IL 60201-1718</td>
</tr>
<tr>
<td>Kerry R. Crane, MD</td>
<td>Children's Hosp. Med. Ctr.</td>
<td>3333 Burnet Ave. Cincinnati, OH 45229-3026</td>
</tr>
<tr>
<td>T. Forrest Dagi, MD</td>
<td>2500 Northside.pkwy, Suite 475</td>
<td>Alpharetta, GA 30004-2243</td>
</tr>
<tr>
<td>Maurice Choux, MD</td>
<td>Hopital Des Enfants</td>
<td>De La Timone, Cotes &amp; Marseilles, 33385 France</td>
</tr>
<tr>
<td>Samuel F. Criccell Jr., MD</td>
<td>5238 Fair Oaks Blvd.</td>
<td>Carmichael, CA 95608-5760</td>
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<td>Washington, DC 20010-2016</td>
</tr>
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<td>Children's Hosp.</td>
<td>219 Brent St., Buffalo, NY 14222-0006</td>
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<td>7315 Llewellyn Dr.</td>
<td>Salt Lake City, UT 84109-1211</td>
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<tr>
<td>S. Michael Constantini, MD</td>
<td>Dana Children's Hosp.</td>
<td>6 Weissman St./Ped. Neurosurg. Tel Aviv, 64329 Israel</td>
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<td>Ohio State Univ.</td>
<td>1531 Jerome Rd. New Orleans, LA 70112-2423</td>
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<td>Div. of Neurosurgery</td>
<td>2600 Ridge Ave. Evanston, IL 60201-1718</td>
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<td>Children's Hosp. Med. Ctr.</td>
<td>3333 Burnet Ave. Cincinnati, OH 45229-3026</td>
</tr>
<tr>
<td>T. Forrest Dagi, MD</td>
<td>2500 Northside.pkwy, Suite 475</td>
<td>Alpharetta, GA 30004-2243</td>
</tr>
</tbody>
</table>
2000 Membership Roster

29th Annual Meeting of the AANS/CNS Section on Pediatric Neurological Surgery
December 6–9, 2000 Coronado (San Diego), CA

Michael R. Engno, MD
NY Spine & Brain Surgery PC
DEPT. OF NEUROSURGERY/HSC T12
Stony Brook, NY 11794-8122

Stephanie E. Einhaus, MD
4425 Barfield Road
Memphis, TN 38117-2441

Dr. Howard M. Eisenberg, MD
University of Maryland/Neurosurgery
22 S. Greene St., #612D
Baltimore, MD 21201-1544

Ibrahim Mustah El Nihom, MD
Scott & White Hosp.
2401 S. 31st St.
Temple, TX 76588-0081

Richard G. Ellenbogen, MD
6436 N.E. 55th
Seattle, WA 98105-2833

Seyed M. Emadiyan, MD
Mountaint Neuro. Inst.
7 McDowell St.
Asheville, NC 28801-4103

Fred J. Epstein, MD
Beth Israel Med. Ctr., N. Div.
170 E. 79th Ave.
New York, NY 10021-7601

Mark D. Erasmus, MD
522 Lomas Blvd., N.E.
Albuquerque, NM 87102-2454

Walter J. Faillace, MD
Univ. of Florida, Jacksonville
DEPT. OF NEUROSURGERY
Jacksonville, FL 32209

Neil Arthur Feldstein, MD
Neurological Inst.
710 W. 168th St., Room #414
New York, NY 10032

David A. Felt, MD
Neurosurgery Spec.
6767-A S. Yale
Tulsa, OK 74136-3302

Edwin G. Fischer, MD
1158 Franklin St., Suite 3B
Boston, MA 02114-5501

Ann Marie Flannery, MD
Med. Coll. of Georgia/Children's Medical Center
1120 15th Street
Augusta, GA 30912-0004

Eldon L. Foltz, MD
DEPT. OF NEUROSURGERY
101 City Dr., Bldg. 3, Suite 81, Room 315
Orange, CA 92660-2801

Paul C. Franceschi, MD PhD
Univ. of Oklahoma HSO/Neuros.
711 Stanton L. Young Blvd., #306
Oklahoma City, OK 73104-5024

Kathleen B. French, MD
9200 Hamaker Ct., Suite B104
Fairfax, VA 22031-2320

Arno H. Fried, MD
Harkenswack Univ. Med. Ctr.
30 Prospect Ave./JWAN Peds Ctr.
Harkenswack, NJ 7601

David M. Frits, MD
Univ. of Chicago MC/Neuro.
5841 S. Maryland Ave., MC 4999
Chicago, IL 60637-1463

Herbert E. Fuchs, MD PhD
Duque Med. Ctr./Neurosurgery, Box 3272
Durham, NC 27710-0001

Norman H. Gahm, MD
103 Brookhaven Rd.
Glastonbury, CT 06033-1810

Joseph H. Gallicich, MD
PO. Box 276
Alpine, NJ 07625-0276

Francis W. Gamauche Jr., MD
Neuroscience Inst.
595 E. 72nd St., 7th Fl.
New York, NY 10021-4099

Sarah J. Gaskill, MD
4499 Medical Dr., Suite 397
San Antonio, TX 76228-3113

Rosemarie Gennuso, MD
1661 Bogard Dr., Suite F
Santa Cruz, CA 95065

Timothy M. George, MD
Box 3272/Depts of Neurosurgery
Durham, NC 27710-0001

Richard E. George Jr., MD
3506 21st St., Suite 499
 Lubbock, TX 79410-1300

P. Langhans Gleason, MD
531 Harlee, Suite D
Santa Fe, NM 87505-4700

John C. Godzorey, MD
2443 De Bar Rd., Suite 34
Anchorage, AK 99506-2566

James T. Goodrich, MD PhD
DEPT. OF NEURO/Montefioe
111 E. 210th St.
Bronx, NY 10467-2401

Liliana C. Goumserova, MD
Children's Hosp., Bader 3
400 Longwood Ave.
Boston, MA 02115-5724

Paul A. Grabb, MD
Children's Hosp.
1600 7th Ave., S., ACC 410
Birmingham, AL 35233-1741

Clarence S. Greene Jr., MD
2500 Elm Ave., #218
Long Beach, CA 90805-1600

Laurence J. Guido, MD
39 Sutton Pl., #15A
New York, NY 10022-2365

Francisco A. Gutierrez, MD
201 E. Horn, 2B-180
Chicago, IL 60611-2980

Jens Hauke, MD
Mogilsbergjege 50
Voldkof 9310 Denmark

Yoon Sua Hahn, MD
DEPT. OF NEURO/Univ. of IL at Chicago College of Med.
113 South Wood St.
Chicago, IL 60612-7320

Stephan J. Haines, MD
MUSC/DEPT. OF NEUROSURGERY
171 Ashley Ave.
Charleston, SC 29425-0001

Sten E. Hakansson, MD
J O Wallins Vag 7
Solna, S-17164 Sweden

Mark G. Hamilton, MD
Alberta Children's Hosp.
1820 Richmond Rd., S.W.
Calgary, AB T1P 2C7 Canada

Lonntie L. Hammargren, MD
3160 S. Maryland Pkwy., Suite 106
Las Vegas, NV 89106-2102

Mary Kathryn Hambrock, MD
8620 Rolling Rd.
Manassass, VA 20110-3628

Michael H. Handler, MD
Thimme Hall, Suite 605
1010 E. 19th Ave.,
Denver, CO 80216-1034

William C. Hanigan, MD PhD
719 W. William Kemp Blvd, Suite 100
Phoenix, AZ 85015-5213

Michael D. Hausew, MD
Carolinas Neurosurgery & Spine
1010 Edgewood Rd., N.
Charlotte, NC 28207-1865

Michael A. Healy, MD
2727 Whistlerch
Tobacco, OH 43453-2433

Don R. Heffner, MD
2015 N. Clark St., Suite 900
Chicago, IL 60614-2703

Leslie C. Hellbusch, MD
111 N. 84th St.
Omaha, NE 68114-1401

David C. Hemmig, MD
2061 Waterton Rd., Suite 3
Waukesha, WI 53186-1871

Robert W. Hendee, MD
4710 Lookout Mountain Cv.
Austin, TX 78731-3654
<table>
<thead>
<tr>
<th>Name</th>
<th>Institution</th>
<th>City, State</th>
</tr>
</thead>
<tbody>
<tr>
<td>E. Bruce Hendrick, MD</td>
<td>63 Leggett Ave.</td>
<td>Elmhurst, ON M9P 1C3 Canada</td>
</tr>
<tr>
<td>Tenoch Herrada-Pineda, MD</td>
<td>Apartado Postal 101-87</td>
<td>Mexico City, 45300 Mexico</td>
</tr>
<tr>
<td>Harold J. Hoffman, MD</td>
<td>110 Bluer St., apt. 607</td>
<td>Toronto, ON M8B2W7 Canada</td>
</tr>
<tr>
<td>Thomas J. Hollbrook Jr., MD</td>
<td>J Medical Park Bld., suite 110</td>
<td>Columbia, SC 29003-6973</td>
</tr>
<tr>
<td>Robert D. Hollenberg, MD</td>
<td>McMaster Univ./Surgery Dept., 1500 Main St., W., Room 448E</td>
<td>Hamilton, ON L8N5G5 Canada</td>
</tr>
<tr>
<td>Gregory W. Hornig, MD</td>
<td>450 W. 87 Terrasse</td>
<td>Shawnee Mission, KS 66207-1919</td>
</tr>
<tr>
<td>Roger Hodgins, MD</td>
<td>3455 Mereia Mark Rd., suite 540</td>
<td>Atlanta, GA 30342</td>
</tr>
<tr>
<td>Stephen L. Huhn, MD</td>
<td>Stanford Univ., 300 Pasteur Dr., R203</td>
<td>Palo Alto, CA 94304-2203</td>
</tr>
<tr>
<td>Robin P. Humphreys, MD</td>
<td>Hosp. for Sick Children</td>
<td>Toronto, ON M5G1X8 Canada</td>
</tr>
<tr>
<td>Bermans J. Ignatius, MD</td>
<td>Univ. of Wisconsin/Neurosurg.</td>
<td>600 Highland Ave., H4/334 Madison, WI 53792</td>
</tr>
<tr>
<td>Hector E. James, MD</td>
<td>7900 Frost St., Suite 4100</td>
<td>San Diego, CA 92123-2738</td>
</tr>
<tr>
<td>John A. Jane, MD PhD</td>
<td>Univ. of Virginia/Neurosurgery</td>
<td>Hosp. Box 212</td>
</tr>
<tr>
<td>David F. Jimenez, MD</td>
<td>Univ. of Missouri Hosp. &amp; Clin</td>
<td>One Hospital Dr., NS21</td>
</tr>
<tr>
<td>Dennis L. Johnson, MD</td>
<td>408 Elm Ave.</td>
<td>Hershey, PA 17033-1711</td>
</tr>
<tr>
<td>John K. Johnson, MD</td>
<td>20 Medical Ridge Dr.</td>
<td>Greenville, SC 29605-5007</td>
</tr>
<tr>
<td>Mary M. Johnson, MD</td>
<td>2223 Chatham Rd.</td>
<td>Atlanta, GA 30306-1101</td>
</tr>
<tr>
<td>Martin Johnson, MD</td>
<td>31560 S.W. Country View Ln.</td>
<td>Wilsonville, OR 97070-7476</td>
</tr>
<tr>
<td>Robert B. Jones, MD</td>
<td>21 Norfolk St.</td>
<td>Paddington, NSW 2021 Australia</td>
</tr>
<tr>
<td>Allen S. Joseph, MD</td>
<td>7777 Honeyway Blvd., suite 10000</td>
<td>Bates Rouge, LA 70806-4300</td>
</tr>
<tr>
<td>John E. Jakubek, MD</td>
<td>Riley Children’s Hosp.</td>
<td>702 Barnhill Dr.</td>
</tr>
<tr>
<td>Paul M. Kanev, MD</td>
<td>Hershey Med. Ctr./Neurosurgery</td>
<td>PO Box 850</td>
</tr>
<tr>
<td>Samuel S. Kosoff, MD</td>
<td>11 Sycamore Ln.</td>
<td>White Plains, NY 10603-5001</td>
</tr>
<tr>
<td>Bruce A. Kaufman, MD</td>
<td>Children’s Hospital of Wisconsin/</td>
<td>Dept of Neurosurgery 9000 W. Wisconsin</td>
</tr>
<tr>
<td>Robert F. Keating, MD</td>
<td>521 35th St., N.W.</td>
<td>Washington, DC 20007</td>
</tr>
<tr>
<td>David L. Kelly Jr., MD</td>
<td>Wake Forest Sch. of Med.</td>
<td>Medical Center Blvd./Neuro.</td>
</tr>
<tr>
<td>John R. W. Keeler, MD</td>
<td>110 N. Medical Dr., Suite 2400</td>
<td>Silt Lake City, UT 84113-1100</td>
</tr>
<tr>
<td>David M. Klein, MD</td>
<td>660 Farrington Post</td>
<td>Pittsburgh, PA 23785-3507</td>
</tr>
<tr>
<td>Laurence J. Kleiner, MD</td>
<td>5054 Indiana Grove Blvd., suite A</td>
<td>Rosnoke, VA 24114-6908</td>
</tr>
<tr>
<td>David N. Kneier, MD</td>
<td>GED 4</td>
<td>8000 Valley Childrens Pl, Madsen, CA 90688-8560</td>
</tr>
<tr>
<td>Edward J. Kosak, MD</td>
<td>Champaign Village Prof. Bldg.</td>
<td>831 Chatham Ln</td>
</tr>
<tr>
<td>Cornelles H. Lams, MD</td>
<td>Code 96 Mayo D-428 Mayo</td>
<td>410 Delaware St., S.E./Neuro.</td>
</tr>
<tr>
<td>John P. Laurent, MD</td>
<td>Texas Childrens Hosp.</td>
<td>6621 Fannin St., MC 3-5435 Houston, TX 77030-2303</td>
</tr>
<tr>
<td>Edward R. Laws Jr., MD</td>
<td>Univ. of Va/Dept Neurosurgery</td>
<td>Health Sciences Ctr., Bk 8002122</td>
</tr>
<tr>
<td>Mark Robert Lee, MD</td>
<td>Med. Coll. of Georgia</td>
<td>1120 15th St./Neuros. BFW-348 Augusta, GA 30902-0004</td>
</tr>
<tr>
<td>Michael Lee Levy, MD</td>
<td>Children’s Hospital</td>
<td>1300 N. Vermont St., suite 906</td>
</tr>
<tr>
<td>Veetai Li, MD</td>
<td>Dept. of Neurosurgery</td>
<td>318 Bryant St.</td>
</tr>
<tr>
<td>Kenneth L. Lipow, MD</td>
<td>267 Grant St.</td>
<td>Bridgeport, CT 06601-2605</td>
</tr>
<tr>
<td>John D. Loeser, MD</td>
<td>Univ of Washington</td>
<td>Box 36476/Neurosurgery</td>
</tr>
<tr>
<td>Morris L. Loffman, MD</td>
<td>16311 Ventura Blvd., suite 1205</td>
<td>Encino, CA 91364-2124</td>
</tr>
<tr>
<td>Rafael Longo-Cordero, MD</td>
<td>Univ. of Washington</td>
<td>Calle Robeco 511</td>
</tr>
<tr>
<td>Ralph C. Loomis, MD</td>
<td>7 McDowell St.</td>
<td>Nashville, TN 37201-4103</td>
</tr>
<tr>
<td>Kenneth M. Louis, MD</td>
<td>3900 E. Fletcher Ave., suite 340</td>
<td>Tampa, FL 33613-4645</td>
</tr>
<tr>
<td>Mark G. Luciano, MD PhD</td>
<td>Cleveland Clinic Foundation</td>
<td>9500 Euclid Ave., S-80</td>
</tr>
<tr>
<td>Thomas G. Lueken, MD</td>
<td>Riley Hosp. for Children</td>
<td>3200 S. Children’s Sq., #5310</td>
</tr>
<tr>
<td>Joseph B. Madsen, MD</td>
<td>Children’s Hosp/Neurosurgery</td>
<td>300 Longwood Ave., Room 312</td>
</tr>
<tr>
<td>Gary Magrini, MD</td>
<td>NJ Neuroscience Inst.</td>
<td>65 James St.</td>
</tr>
</tbody>
</table>
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Section on Pediatric Neurological Surgery
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Coronado (San Diego), CA

Anthony F. Sussen, MD
180 Old Globe Point Rd.
Burrage, VA 22343-2006

Leelle N. Sutton, MD
Child. Hosp. of Philadelphia
34th & Civic Center Blvd.
Philadelphia, PA 19104

Michael S. Taekman, MD
15 Oakmont Ctr.
San Rafael, CA 94901-1235

John M. Tow Jr., MD
Mayfield Clinic, 596 Oak St.
Cincinnati, OH 45219-2507

Tafafuri Tomita, MD
Children’s Hosp./Neuros. 2300 Children’s Plaza, Box 2B
Chicago, IL 60614-3953

Eric R. Trumbull, MD
22 W. Lake Beauty Dr., Ste. 304
Orlando, FL 32806-3035

Noel Tulipan, MD
8533 McCray Ln.
Nashville, TN 37221-5005

Michael S. Turner, MD
1801 N. Senate Blvd., Suite 535
Indianapolis, IN 46202-1228

David D. Udeshi, MD
4300 Seventh St.
Melrose, IL 60095-6870

Ronald H. Ustelinski, MD
3301 Woodburn Rd., 8906
Annandale, VA 22003-1229

Michael Vassilikis, MD
Children’s Hosp. East Ontario
401 Smyth Rd.
Ottawa, NB K1H 8L1 Canada

Joan L. Venes, MD
1810 North Bend Dr.
Sacramento, CA 95814-5101

Enrique C. Victorleyra, MD
401 Smyth Rd.
Ottawa ON K1H 8L1 Canada

John Kenric Vries, MD
Univ. of Pittsburgh
217 Victoria Bldg.
Pittsburgh, PA 15261-0001

Steven L. Wald, MD
Children’s Medical Center
One Children’s Plaza
Dallas, TX 75244-1696

John R. Waldman, MD
Albany Med. Coll.
Div. of Neurosurgery/CMC-NE
Albany, NY 12208

Marion L. Walker, MD
Primary Children’s Med. Ctr.
100 N. Medical Dr./Ped. Neuro.
Salt Lake City, UT 84113-9103

John William Walsh, MD
Tulane Univ. McGovern Neurosurgery
1430 Tulane Ave., SL-47
New Orleans, LA 70112

John D. Ward, MD
Virginia Commonwealth Univ.
Box 990301
Richmond, VA 23298-0301

Benjamin C. Warf, MD
700 Delaware Rd.
Lexington, KY 40516

Martin H. Weiss, MD
USC Med. Ctr., Box 796
1200 N. State St., Room 5046
Los Angeles, CA 90033-1029

Robert Joseph White, MD PhD
Department Of Neurosurgery
2400 MetroHealth Dr.
Cleveland, OH 44109-1900

Jean K. Wickersham, MD
3030 Children’s Way, Suite 402
San Diego, CA 92123-4228

Phillip J. A. Willman, MD
1415 3rd St., Suite 102
Corpus Christi, TX 78404-2107

Ronald J. Wilson, MD
101 S. Moyer Expwy., Blvd. V, Suite 210
Austin, TX 78746-3776

Jeni W. Whorer, MD
York Neurosurgical Assn., PC
3319 S. George St.
York, PA 17401-5009

Kees R. Winston, MD
1068 E. 19th Ave.
Box 8780
Deaver, CO 80218-1007

Jeffrey H. Wisoff, MD
550 1st Ave.
New York, NY 10016

Daniel Woo, MD
Pediatric Neurosurgical Associates
301 Vanderbilt Way, 4105
San Bruno Rd., CA 92408-2920

Meredith V. Woodward, MD
4308 W. Alvarado
Fresno, CA 93722

Shokri Yamada, MD
Room 25628/Neurosurgery
Lesno Linda Univ. Sch. of Med.
Los Angeles, CA 90250-0001

Karol Zakalik, MD
5555 W. 13 Mile Rd., Suite 304
Royal Oak, MI 48073-6710

Abdul Zakria, MD
4205 Saco Rd.
Toledo, OH 43623-2423

Edward J. Zampella, MD
10 Parrott Mill Rd.
P.O. Box 886
Chatsworth, NJ 07928-2744

Lois Mansel Zavala, MD
1900 Mowery Ave., Ste. F
Pompton, CA 95438-1723

John G. Zevickian, MD
3000 Calhoun St., Suite 101
Berkeley, CA 94705-2058