30th Annual Meeting of the American Association of Neurological Surgeons and Congress of Neurological Surgeons Section on

PEDIATRIC NEUROLOGICAL SURGERY

Program Book

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

The Program Book was made possible, in part, by an educational grant provided by Codman, a Johnson & Johnson Company.

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AANS/CNS Section on Pediatric Neurological Surgery

30th Annual Meeting
November 28–December 1, 2001
New York, NY

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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 American Association of Neurological Surgeons is accredited by the Accreditation Council for Continuing Medical Education (ACCME) to provide continuing medical education for physicians.

The American Association of Neurological Surgeons designates this educational activity for a maximum of 19.5 hours in category 1, toward the AMA Physician's Recognition Award, with an additional 4.5 hours for the Post-meeting Coding Course. Each physician should claim only those hours that he or she actually spends in the educational activity.

TABLE OF CONTENTS

Annual Winter Meeting Sites

1972	Cincinnati
1973	Columbus
1974	Los Angeles
1975	Philadelphia
1976	Toronto
1977	Cleveland
1978	Philadelphia
1979	New York
1980	New York
1981	Dallas
1982	San Francisco
1983	Toronto
1984	Salt Lake City
1985	Houston
1986	Pittsburgh
1987	Chicago
1988	Scottsdale
1989	Washington, D.C.
1990	San Diego & Pebble Beach
1991	Boston
1992	Vancouver, BC
1993	San Antonio
1994	St. Louis
1995	Pasadena
1996	Charleston
1997	New Orleans
1998	Indianapolis
1999	Atlanta
2000	San Diego
2001	New York
2002	Phoenix
2003	Miami
2004	San Francisco
2005	Birmingham

KENNETH SHULMAN AWARD RECIPIENTS

1983 KIM MANWARING—Neonatal Post-Hemorrhagic Ventriculomegaly: Management with Pulsed Lumbar Cisternostomy

1984 ARNO FRIED—A Laboratory Model of Shunt-Dependent Hydrocephalus

1985 ANNE-CHRISTINE DUHAIME—The Shaken Baby Syndrome

1986 ROBERT E. BREEZE—CSF Formation in Acute Ventriculitis

1987 MARC R. DELBIGIO—Shunt-Induced Reversal of Periventricular Pathology in Experimental Hydrocephalus

1988 SCOTT FALCI—Rear Seat-Lap Belts. Are They Really "Safe" for Children?

1989 JAMES M. HERMAN—Tethered Cord as a Cause of Scoliosis in Children with a Myelomeningocele

1990 CHRISTOPHER D. HEFFNER—Basilar Pons Attracts Its Cortical Innervation by Chemotropic Induction of Collateral Branch Formation

1991 P. DAVID ADELSON—Reorganization of the Cortical-Tectal Pathway Following Neonatal Cerebral Hemispherectomy in Cats

1992 DAVID FRIM—Effects of Biologically Delivered Neurotrophins in Animal Models of Neural Degeneration

1993 MONICA C. WEHBY—Metabolic Demonstration of Retained CNS Function in the Rabbit Model of Infantile Hydrocephalus

1994 ELLEN SHAVER—Experimental Acute Subdural Hemotoma in Infant Piglets

1995 SEYED M. EMADIAN—Correlation of Chromosome 17p Loss with Clinical Outcome in Patients with Primitive Neuroectodermal Tumors

1996 JOHN PARK, MD, PHD—Platelet Derived Growth Factor Induces Differentiation of Neuroepithelial Stem Cells into Neurons

1997 MICHAEL J. DREWEK, MD—Quantitative Analysis of the Toxicity of Human Amniotic Fluid to Rat Fetal Spinal Cord Cultures

1998 ADRIANA RANGER—Implantation of Medulloblastoma Cells into Collagen Type I Gels: Invasiveness, Enzymatic Characterization, and the Impact of Surgical Excision and Radiation

1999 SUSAN DURHAM, MD—The Surprisingly Sturdy Infant Brain: Why Is It More Resistant to Focal Injury

2000 KETAN R. BULSARA, MD—Novel Findings in the Development of the Normal and Tethered Filum Terminale

2001 TBA

HYDROCEPHALUS ASSOCIATION AWARD RECIPIENTS

1989 ERIC ALTSCHULER—Management of Persistent Ventriculomegaly Due To Altered Brain Compliance

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

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

1992 MARCIA DASILVA—Reversal of High Energy Phosphate Metabolism Changes in Experimental Hydrocephalus after CSF Shunting

1993 CHARLES BONDURANT—The Epidemiology of Cerebrospinal Fluid Shunting

1994 MONICA C. WEHBY-GRANT—The Rabbit Model for Infantile Hydrocephalus: Regional Differences in the Cortical Metabolic Response to Hydrocephalus and Shunting

1995 RICHARD J. FOX—Cerebrospinal Fluid Absorptive Site of the Parasagittal Dura: A Cadaveric Study

1996 MARTHA J. JOHNSON—Reactive Astrocytosis in a New Model of Obstructive Hyrocephalus

1997 No prize awarded.

1998 DANIEL LIEBERMAN—In Vetro Detection of Fluid Flow in Ventriculoperitoncal Shunts (VPS) Using Contrast Enhanced Ultrasound

1999 KIMBERLY BINGAMAN— Hydrocephalus Induces the Proliferation of Cells in the Subventricular Zone

2000 No prize awarded.

2001 TBA

LECTURERS

Matson Memorial Lecturers

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

Raimondi Lecturers

1978	E. Bruce Hendrick	1990	George R. Leopold
1979	Paul C. Bucy	1991	Judah Folkman
1980	Floyd Gilles	1992	Olof Flodmark
1981	Panel Discussion	1993	Maurice Albin
1982	Panel Discussion	1994	Blaise F.D. Bourgeois
1983	Derek Harwood-Nash	1995	Robert H. Pudenz
1984	Anthony E. Gallo, Jr.	1996	Samuel S. Flint
1985	Frank Nulsen	1997	M. Michael Cohen, Jr.
1986	William F. Meacham	1998	Robert A. Zimmerman
1987	Dale Johnson	1999	David B. Schurtleff
1988	Joseph J. Volpe	2000	Steve Berman
1989	Martin Eichelberger	2001	Alejandro Berenstein

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R. Leopold

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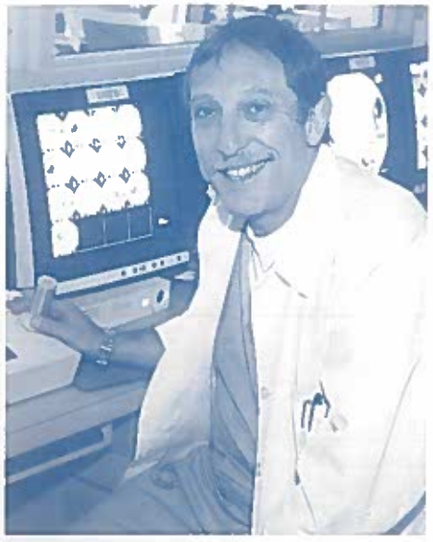
2001 RAIMONDI LECTURER

Alejandro Berenstein, MD



Alejandro Berenstein, MD, came to Beth Israel from New York University Medical Center, where he entered on a fellowship in diagnostic neuroradiology in 1976, and then remained for 20 years.

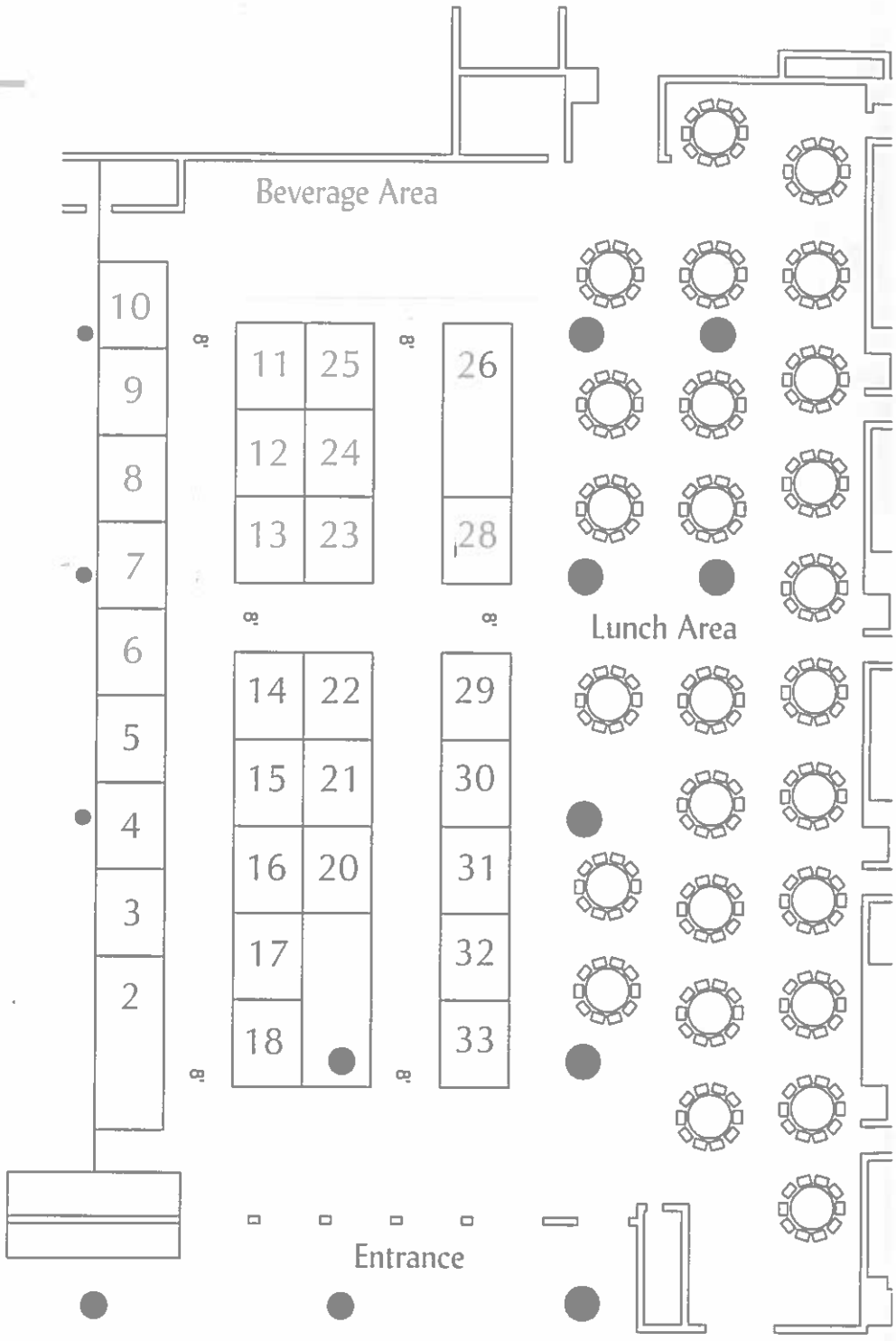
He is a pioneer in the emerging field of interventional neuroradiology, with use of a minimal invasive procedure to treat conditions related to the vascular system in the brain, head, face, spine, and spinal cord. Dr. Berenstein created and developed the first division of interventional neuroradiology (surgical neuroangiography) in the United States, recognizing complex vascular problems of the brain and spinal cord. He also developed the first multidisciplinary center for congenital vascular anomalies and hemangiomas where a team of specialists review and design treatment strategies for patients with vascular problems of the head and neck.

Dr. Berenstein uses the same concepts, techniques and multidisciplinary expertise at the INN in cases of aneurysm, vascular tumors, vascular malformation, birth marks and other vascular abnormalities. In addition, this group of experts will further advance the field of surgical neuroangiography by creating one of the most comprehensive stroke (brain attack) centers in the country. With Dr. Pierre Lasjuanias, Dr. Berenstein co-wrote the five-volume definitive work in the field of surgical neuroangiography.

A native of Mexico City, Mexico, Dr. Berenstein received his Bachelor of Science Degree from the Escuela Secundaria y Preparatory de la Ciudad de Mexico. Dr. Berenstein now lives in New York City with his wife, Marie Josie and two daughters, Vanessa and Erica.

EXHIBIT HALL FLOOR PLAN

MARRIOTT MARQUIS
WESTSIDE BALLROOM
NEW YORK, NY



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Wednesday, November 28, 2001

12:00 Noon–5:00 PM
Nurses' Seminar

Learning Objectives:

1. Describe current surgical strategies which can be utilized in epilepsy management.
2. Identify pain management strategies which can be incorporated into practice.
3. Identify resources which can be utilized to inform patients and family members about various neurosurgical conditions.

12:00 Noon–5:00 PM
Nurses' Seminar

The Nurses' Seminar will include presentations on surgical management of epilepsy pain in children, a review of current patient educational materials and an update or the Hydrocephalus Association activities.

2:00 PM–6:00 PM
Registration

2:00 PM–6:00 PM
Poster Setup for Medical Registrants

6:00 PM–7:30 PM
Opening Reception with Exhibitors on the 37th Floor Skylobby of the Marri Marquis

Thursday, November 29, 2001

Please Note

Oral Abstracts indicated with an (H) are being considered for the Hydrocephalus Foundation of Northern California Award. And those with an (S) are being considered for The Shulman Memorial Award.

7:00 AM–5:30 PM
Registration

7:00 AM–8:00 AM
Continental Breakfast with Exhibit Viewing

7:00 AM–8:00 AM
Poster setup for Medical Registrants

8:00 AM–8:10 AM
Welcoming and Opening Remarks

8:10 AM–10:00 AM
Scientific Session I—Neuro-oncology

Moderators: P. Steinbok, MD; H. Weiner, MD

Learning Objectives:

1. Recognize current treatment practices for tumors of the central and peripheral nervous system.
2. Recognize current research trends for pediatric tumors of the central and peripheral nervous system.

8:10 AM–8:20 AM
1. Craniopharyngioma

Robert A. Sanford, MD (Memphis, TN), Larry E. Kun, MD (Memphis, TN), Thomas F. Merchant, D.O., Ph.D. (Memphis, TN).

8:20 AM–8:30 AM
2. Expression of Vascular Endothelial Growth Factor Receptors in CNS and P Tumors

Catherine A. Mazzola, MD (Pittsburgh, PA), Ricky Madhok, MS (Newark, NJ), Leroy Sharer, MD (Newark, NJ), Lucy Cho, MD (Newark, NJ), Allen H Maniker, MD (Newark, NJ).

8:30 AM–8:40 AM
3. Does Histological Subclassification Have Any Predictive Value for the Lon term Prognosis of Children with Cerebellar Astrocytomas?

Flemming Gjerris, MD,D.Sc. (Copenhagen, Denmark), Tine Bernhardtsen, MD (Copenhagen, Denmark), Henning Laursen, MD,D Sc. (Copenhagen, Denmark), Jens Haase, MD (Aalborg, Denmark), Marie Bojsen-Moeller, MD (Aarhus, Denmark).

8:40 AM–8:50 AM

4. Cerebellar Tumor Resection in Childhood followed by Transient Cerebellar Mutism: An Investigation of Residual Speech Deficits in Long-Term Survivors

Joelene F. Huber-Okrainec, M.Sc.(A) S-LP (Toronto, Ontario), Maureen Dennis, Ph.D. (Toronto, Ontario), Kim Bradley, Ph.D. (Toronto, Ontario), Brenda J. Spiegler, Ph.D. (Toronto, Ontario).

8:50 AM–9:00 AM

5. Cytogenetics in Recurrent Ependymoma

Michael H. Handler, MD (Denver, CO), Josephine Wyatt-Ashmead, MD (Jackson, MS), Julie Fleitz, MD (Denver, CO), Nicholas Foreman, MD (Denver, CO).

9:00 AM–9:10 AM

6. Delayed Surgical Resection for Central Nervous System Germ Cell Tumors

Howard L. Weiner, MD (New York, NY), Roger A. Lichtenbaum, MD (New York, NY), Jeffrey H. Wisoff, MD (New York, NY), Mark Souweidane, MD (New York, NY), Jeffrey N. Bruce, MD (New York, NY), Robert B. Snow, MD (New York, NY), Jonathan L. Finlay, MB,ChB (New York, NY).

9:10 AM–9:20 AM

7. Multi-agent Neoadjuvant Chemotherapy Followed by Response Dependent Reduced Dose Radiotherapy for Newly Diagnosed Germinoma in Children

George I. Jallo, MD (New York, NY), Victoria LaMarca, PNP (New York, NY), Linda Velasquez, MS (New York, NY), Karl Kothbauer, MD (New York, NY), Jeff Allen, MD (New York, NY), Joao Siffert, MD (New York, NY).

9:20 AM–9:30 AM

8. Synergistic Effect of Genistein and BCNU on Growth Inhibition and Cytotoxicity of Glioblastoma Cells

David J. Nathan, MD (Burlington, VT), Sami Khoshyomn, MD (Burlington, VT), Gregory C. Manske, BS (Burlington, VT), Turner M. Osler, MD (Burlington, VT), Paul L. Penar, MD (Burlington, VT).

9:30 AM–9:40 AM

9. Optic Nerve Decompression in Fibrous Dysplasia. Technique and Long Term Results

Derek A. Bruce, MD (Dallas, TX), Kenneth M. Shapiro, MD (Dallas, TX), Dale Swift, MD (Dallas, TX), Jeffrey Fearon, MD (Dallas, TX), Kenneth Salyer, MD (Dallas, TX).

9:40 AM–9:50 AM (S)

10. Rhabdoid Tumors of the Central Nervous System: Clinical, Radiographic and Pathologic Features

Nicholas C. Bambakidis, MD (Cleveland, OH), Alan R. Cohen, MD (Cleveland, OH).

9:50 AM–10:00 AM

11. Medulloblastoma:Treatment and Results in Birmingham Childrens Hospital, (1992–1999)

Anil Sivasankaran, (Birmingham, UK), E.C. Leung, (Birmingham, UK), Anthony D. Hockley, (Birmingham, UK), Spyros Sgouros, (Birmingham, UK), A. Richard Walsh, (Birmingham, UK), Michael Stevens, (Birmingham, UK), Richard Grundy, (Birmingham, UK), David Spooner, (Birmingham, UK), Sheila Parkes, (Birmingham, UK).

10:00 AM–10:30 AM

Scientific Session II—Invited Lecture: Update on CCG Protocols, Ian Pollack, MD

Moderator: R. Sanford, MD

Learning Objectives:
1. Identify current treatment practices for pediatric tumors of the central and peripheral nervous system.

10:00 AM–10:30 AM
Invited Lecture: Update on CCG Protocols, Ian Pollack, MD

10:30 AM–11:00 AM
Beverage Break with Exhibits and Poster Viewing

11:00 AM–12:30 PM

Scientific Session III—Neuro-oncology

Moderators: T. George, MD; D. Bruce, MD

Learning Objectives:
1. Evaluate current treatment practices for pediatric tumors of the central and peripheral nervous system.
2. Evaluate current research trends for pediatric tumors of the central and peripheral nervous system.

11:00 AM–11:10 AM (S)
12. Characterization of a Hypoxia-Dependent Replicative Adenovirus for the Treatment of Malignant Brain Tumors
Prithvi Narayan, MD (Atlanta, GA), Sarojini Devi, BS (Atlanta, GA), Dawn E. Post, Ph.D. (Atlanta, GA), Erwin B. Van Meir, Ph.D. (Atlanta, GA).

11:10 AM–11:20 AM (S)
13. Convection-Enhanced Delivery into the Rat Brain Stem: A Potential Delivery Mechanism for the Treatment of Diffuse Pontine Gliom
David I. Sandberg, MD (New York, NY), Mark A. Edgar, MD (New York, NY), Mark M. Souweidane, MD (New York, NY).

11:20 AM–11:30 AM
14. Spontaneous Regression of a Diffuse Brain Stem Lesion in the Neonate: Report of Two Cases & Review of the Literature
Willard D. Thompson, MD (Columbus, OH), Ed Kosnik, MD (Columbus, OH).

11:30 AM–11:40 AM
15. Application of the Orbito-cranial Approach in Pediatric Neurosurgery
Shlomi Constantini, MD M.Sc (Tel-Aviv, Israel), Vitaly Siomin, MD, (Tel-Aviv, Israel), Sergey Spektor, MD (Tel-Aviv, Israel), Liana Beni-Adani, M.D (Tel-Aviv, Israel).

11:40 AM–11:50 AM
16. Spinal Cord Mapping as an Adjunct for Resection of Intramedullary Tum
Alfredo Quinones-Hinojosa, MD (San Francisco, CA), Russ Lyon, M.S. (San Francisco, CA), Mittul Gulati, A.B. (San Francisco, CA), Charles Yingling, Ph.D. (San Francisco, CA), Nalin Gupta, MD, Ph.D. (San Francisco, CA).

11:50 AM–12:00 Noon
17. Magnetic Resonance Screening for Occult Pediatric Spinal Intradural Metastases
Sanjay N. Misra, MD (Dallas, TX), Lynn Gargan, PhD (Dallas, TX), Simpson Georgeanna, (Dallas, TX), Weprin Brad, MD (Dallas, TX), Bruce Derek, MD (Dallas, TX).

12:00 Noon–12:10 PM (S)
18. Pediatric Tectal Tumors: The Experience at Children's Hospital, Boston
Sean M. Lew, MD (Boston, MA), Liliana C. Goumnerova, MD (Boston, MA).

12:10 PM–12:20 PM (S)

19. Germline Mutations of Human Suppressor of Fused Predispose to Medulloblastoma and Gorlin's Syndrome Through Failure to Suppress Sonic Hedgehog and Wnt Signaling

Michael D. Taylor, MD (Toronto), David Hogg, MD (Toronto), Corey Raffel, MD PhD (Rochester, MN), Ling Liu, MD (Toronto), Todd G. Mainprize, MD (Toronto), C.C. Hui, PhD (Toronto), Sharon Chiappa, PhD (Rochester, MN), Steve Scherer, PhD (Toronto), James T. Rutka, MD PhD (Toronto).

12:20 PM–12:30 PM

20. Brain Tumors in the First Two Years of Life: The CHEO Experience

Khalid Almusrea, MD (Ottawa), Michael Vassilyadi, MD (Ottawa), Enrique C.G. Ventureyra, MD (Ottawa).

12:30 PM–1:45 PM

Lunch in the Exhibit Hall and Poster Viewing

1:45 PM–2:10 PM

Life Time Achievement Award—
Luis Schut, MD

Presenter: Thomas G. Luerssen, MD

2:10 PM–3:30 PM

Scientific Session IV—Perinatal and Congenital Anomalies

Moderators: A.C. Duhaime, MD; L. Goumnerova, MD, FRCSC

Learning Objectives:

1. Identify current treatment practices for perinatal and congenital anomalies.
2. Identify current research trends for perinatal and congenital anomalies.

2:10 PM–2:20 PM

21. Developmental Brain Insults and their Effects on the Localization of Speech and Motor Cortex

Shenandoah Robinson, MD (Cleveland, OH), Monisha Goval, MD (Cleveland, OH), Tarif Bakdash, MD (Cleveland, OH), Max Wiznitzer, MD (Cleveland, OH), Mark Scher, MD (Cleveland, OH), Barbara Swartz, MD (Cleveland, OH).

2:20 PM–2:30 PM (S)

22. Protective Effect of Hyperbaric Oxygen on Hypoxia-ischemia in Neonatal Rats

Andrew D. Parent, MD (Jackson, MS), Wei Yin, MD, PhD (Jackson, MS), Ahmed Badr, MD (Jackson, MS), George Mychaskiw, MD (Jackson, MS), John H. Zhang, MD, PhD (Jackson, MS).

2:30 PM–2:40 PM

23. Potentially Fatal "Blue Spells" in Patients with Brainstem Dysfunction: A Review of Five Patients

Donna Wallace, PNP (Phoenix, AZ), Harold Rekate, MD (Phoenix, AZ).

2:40 PM–2:50 PM (H)

24. Management of Prenatally Diagnosed CNS Anomalies

Ramin J. Javahery, MD (Miami, FL), John Ragheb, MD (Miami, FL), Glenn Morrison, MD (Miami, FL).

2:50 PM–3:00 PM

25. Ventricular Volume in Hindbrain Hernia (Chiari I) in Children

Christos Tolias, (Birmingham, UK), Kal Natarajan, (Birmingham, UK), Spyros Sgouros, (Birmingham, UK).

3:00 PM–3:10 PM

26. Peculiarities in the Very Young Patient with Chiari I Malformation

Jeremy D.W. Greenlee, MD (Iowa City, IA), David M. Hasan, MD (Iowa City, IA), Kathleen Donovan, ARNP (Iowa City, IA), Arnold H. Menezes, MD (Iowa City, IA).

3:10 PM–3:20 PM

27. Pseudotumor Cerebri Associated with Treatment for Chiari Malformation Type 1

David M. Frim, MD, PhD (Chicago, IL), Lisa Fagan, MA (Chicago, IL).

3:20 PM–3:30 PM

28. Leonardo daVinci and Virtual Reality: Esthetic Criteria in Surgery for Craniosynostosis

Hannes Haberl, MD (Berlin, Germany).

3:30 PM–4:00 PM

Beverage Break with Exhibits and Poster Viewing

4:00 PM–5:30 PM

Scientific Session V—Perinatal and Congenital Anomalies

Moderators: J. Madsen, MD; M. Souweidane, MD

Learning Objectives:

1. Assess current treatment practices for perinatal and congenital anomalies.
2. Assess current research trends for perinatal and congenital anomalies.

4:00 PM–4:10 PM

29. Pediatric Alloplastic Resorbable Cranioplasty

Steven J. Schneider, MD, FACS, FAAP (New Hyde Park, NY).

4:10 PM–4:20 PM

30. Cranial Molding Helmets Following Treatment of Craniosynostosis: Four Year Experience with 268 Helmets

David F. Jimenez, MD (Columbia, MO), Constance M. Barone, MD (Columbia, MO), Cartwright Cathy, RN (Columbia, MO).

4:20 PM–4:30 PM

31. Mild Trigonocephaly Associated with Clinical Symptoms

Takeyoshi Shimoji, MD (Okinawa, Japan), Satoshi Shimabukuro, (Okinawa, Japan), Seuchi Sugama, (Tokyo, Japan).

4:30 PM–4:40 PM

32. Novel Technique for Minimally Invasive Correction of Metopic Synostosis

Soren A. Singel, MD (San Diego, CA), Hal S. Meltzer, MD (San Diego, CA), Ralph Holmes, MD (San Diego, CA), Steven Cohen, MD (San Diego, CA).

4:40 PM–4:50 PM

33. Are Lipomyelomeningoceles Always Associated with Tethered Cord Syndrome?

Shokei Yamada, MD,PhD (Loma Linda, CA), David S. Knierim, MD (Loma Linda, CA), Daniel J. Won, MD (Loma Linda, CA), Santiago J. Figuereo, MD (Loma Linda, CA), Franky Almagud, BS,M

4:50 PM–5:00 PM

34. Outcome Following Reoperations for Tethered Spinal Cords Associated with Closed Neural Tube Defects and Lipomatous Malformations

Hulda B. Magnadottir, MD, MS (Lebanon, NH), J. Gordon McComb, MD (Los Angeles, CA), Michael L. Levy, MD (Los Angeles, CA).

5:00 PM–5:10 PM

35. Is the Myelomeningocele Placode Normal?—An Immunohistochemical Analysis with Implications for Fetal Surgery

Timothy M. George, MD (Durham, NC), Thomas J. Cummings, MD (Durham, NC).

5:10 PM–5:20 PM

36. Intrauterine Myelomeningocele Repair Reduces the Incidence of Shunt-Dependent Hydrocephalus

Noel B. Tulipan, MD (Nashville, TN), Leslie N. Sutton, MD (Philadelphia, PA), N. Scott Adzick, MD (Philadelphia, PA), Joseph P. Bruner, MD (Nashville, TN).

5:20 PM–5:30 PM (S)

37. Discernment of Adipose Versus Nervous Tissue Using a Novel Solvent: A Potential Application in Lipomyelomeningoceles

Ravish V. Patwardhan, MD (Birmingham, AL), Richard S. Tubbs, PA-C (Birmingham, AL), Robert J. Leonard, Ph.D. (Riverside, CA), David Kelly, MD (Birmingham, AL), Cheryl Killingsworth, D.V.M. (Birmingham, AL), Dennis L. Rollins, M.S. (Birmingham, AL), William M. Smith, Ph.D. (Birmingham, AL), Raymond E. Ideker, MD, Ph.D. (Birmingham, AL), W. Jerry Oakes, MD (Birmingham, AL).

5:30 PM–6:15 PM

Annual Business Meeting

Friday, November 30, 2001

Please Note

Oral Abstracts indicated with an (H) are being considered for the Hydrocephalus Foundation of Northern California Award. And those with an (S) are being considered for The Shulman Memorial Award.

7:00 AM–6:00 PM

Registration

7:00 AM–8:00 AM

Continental Breakfast with Exhibit Viewing

8:00 AM–9:30 AM

Scientific Session VI—Childhood Spasticity

Moderators: T.S. Park, MD; A. Cohen, MD

Learning Objectives:

1. Discuss current treatment practices for childhood spasticity.
2. Discuss current research trends for childhood spasticity.

8:00 AM–8:10 AM

38. Management of Pediatric Intrathecal Baclofen Pump Complications

David John Yeh, MD (Augusta, GA), Mark R. Lee, MD, Ph.D (Augusta, GA), Ann Marie Flannery, MD (Augusta, GA), Elizabeth Moberg-Wolff, MD (Augusta, GA), Sandy E. Chernich, PA-C (Augusta, GA), John B. Adams, BS (Augusta, GA).

8:10 AM–8:20 AM (H)

39. Energy Efficiency of Gait: Rhizotomy and Orthopedic Surgery

Joseph H. Piatt, MD (Philadelphia, PA), Susan Sienko Thomas, MA (Portland, OR), Cathleen H. Buckon, MS (Portland, OR), Michael D. Aiona, MD (Portland, OR), Michael D. Sussman, MD (Portland, OR).

8:20 AM–8:30 AM

40. Changes in Gait at 8 Months After Selective Dorsal Rhizotomy

Jack R. Engsberg, PhD (St. Louis, MO), Sandy A. Ross, PT, MHS (St. Louis, MO), Joanne Wagner, PT, MS, ATC (St. Louis, MO), T. S. Park, MD (St. Louis, MO).

8:30 AM–8:40 AM

41. Strength and Cocontraction after Rhizotomy for Spastic Diplegia

Joseph H. Piatt, MD (Philadelphia, PA), Cathleen E. Buckon, MS (Portland, OR), Susan Sienko Thomas, MA (Portland, OR), Gerald E. Harris, PhD (Milwaukee, WI), Michael D. Aiona, MD (Portland, OR), Michael D. Sussman, MD (Portland, OR).

8:40 AM–8:50 AM (S)

42. Long-Term Functional Outcome Following Selective Posterior Rhizotomy

Sandeep Mittal, MD (Montreal, Canada), Jean-Pierre Farmer, MD (Montreal, Canada), Borhan Al-Atassi, BSc (Montreal, Canada), Johanne Gibis, PhT (Montreal, Canada), Kathleen Montpetit, OT (Montreal, Canada), Chantal Poulin, MD (Montreal, Canada), Marie-Andre Cantin, MD (Montreal, Canada), Thierry Benaroch, MD (Montreal, Canada).

8:50 AM–9:00 AM

43.Comparison of Motor Outcomes After Selective Dorsal Rhizotomy with and without Preoperative Intensive Physiotherapy in Children with Spastic Diplegic Cerebral Palsy

Paul Steinbok, M.B.Bs, FRCSC (Vancouver, BC,), Kimberley McLeod, P.T (Vancouver, BC).

9:30 AM–10:00 AM

Scientific Session VII—Special Lecture: Update in the Treatment of Childhood Movement Disorders by Leland Albright, MD

Moderators: F. Boop, MD

Learning Objectives:

1. Recognize current treatment practices for childhood movement disorders.
2. Recognize current research trends for childhood movement disorders.

9:30 AM–10:00 AM
Special Lecture: Update in the Treatment of Childhood Movement Disorders
Leland Albright, MD

10:00 AM–10:30 AM
Beverage Break with Exhibits and Poster Viewing

10:30 AM–11:40 AM

Scientific Session VIII—Childhood Epilepsy

Moderators: J.P. Farmer, MD; M. Egnor, MD

Learning Objectives:

1. Evaluate current treatment practices for childhood epilepsy.
2. Evaluate current research trends for childhood epilepsy.

10:30 AM–10:40 AM
44. Complications of Invasive Monitoring Used in Intractable Pediatric Epilep
Scott L. Simon, MD (Philadelphia, PA), Albert Telfeian, MD, Phd (Philadelphia, PA), Ann-Christi Duhaime, MD (Philadelphia, PA).

10:40 AM–10:50 AM
45. Intracranial EEG and SISCOM in Localization of Epileptogenic Zone in Pediatric Patients with Intractable Partial Epilepsy
Nicholas M. Wetjen, MD (Rochester, MN), Gregory D. Cascino, MD (Rochester, MN), Jeffrey R. Buchhalter, MD, Ph.D. (Rochester, MN), Corey Raffel, MD, Ph.D. (Rochester, MN).

10:50 AM–11:00 AM
46. Memory Retrieval Resets Theta Oscillations in Patients Undergoing Invas Monitoring for Epilepsy
Joseph R. Madsen, MD (Boston, MA), Daniel S. Rizzuto, (Brandeis University, MA), David Seelig, (Boston, MA), Michael J. Kahana, PhD (Brandeis, MA).

11:00 AM–11:10 AM (S)
47. Surgical Treatment of Temporal Lobe Epilepsy in Pediatric Patients
Sandeep Mittal, MD (Montreal, Canada), Jose L. Montes, MD (Montreal, Canada), Jean-Pierre Farmer, MD (Montreal, Canada), Jean-Guy Villemure, MD (Lausanne, Canada), Bernard Rosenbla MD (Montreal, Canada), Frederick Andermann, MD (Montreal, Canada), Andre Olivier, MD, Phl (Montreal, Canada).

11:10 AM–11:20 AM (H)
48. Clinical and Seizure Outcome in Pediatric Dysembryoplastic Neuroepithelial Tumor: A Series of 47 Cases
John Wadley, FRCS (London, UK), Joan Grieve, FRCS (London, UK), William Harkness, FRCS (London, UK), Dominic Thompson, FRCS (London, UK), Brian Harding, FRCPath (London, UK), Richard Hayward, FRCS (London, UK).

11:20 AM–11:30 AM
49. Corpus Callosotomy and Vagus Nerve Stimulation: Comparison of Resul in Children with Refractory Epilepsy
Nejat Akalan, MD (Ankara, Turkey), Pinar Ozisik, MD (Ankara, Turkey), Oguz Cataltepe, MD (Ankara, Turkey), Dilek Yanlizoglu, MD (Ankara,Turkey), Guzide Turanli, MD (Ankara, Turkey), Meral Topcu, MD (Ankara, Turkey).

11:30 AM–11:40 AM

50. Vagal Nerve Stimulation in Childhood Epilepsy: the Liverpool and Manchester Experience

Jim Leggate, FRCS (Manchester, England), Paul L. May, FRCS (Liverpool, England), J Z Hussein, FRCS (Manchester, England), Hesham S. Zaki, FRCS (Liverpool, England).

11:40 AM–12:15 PM

Raimondi Lecture Interventional Neuroradiology: A Look into the Future by Alejandro Berenstein, MD

Moderator: R. Abbott, MD

Learning Objectives:

1. Identify future treatment practices for childhood cerebrovascular disease.
2. Identify current research trends for childhood cerebrovascular disease.

11:40 AM–12:15 PM

Raimondi Lecture

Interventional Neuroradiology: A Look into the Future by Alejandro Berenstein, MD

12:15 PM–1:30 PM

Lunch in the Exhibit Hall

1:30 PM–3:30 PM

Scientific Session IX—Cerebrovascular Disease and Hydrocephalus

Moderators: M. Dias, MD; N. Feldstein, MD

Learning Objectives:

1. Identify current treatment practices for childhood cerebrovascular disease and hydrocephalus.
2. Identify current research trends for childhood cerebrovascular disease and hydrocephalus.

1:30 PM–1:40 PM

51. Surgical Revascularisation for Occlusive Cerebrovascular Disease in Childhood

Dominic NP Thompson, FRCS (London, England), Vijaya Ganesan, MRCP (London, England), John Lumley, FRCS (London, England), Brian Neville, MRCP (London, England).

1:40 PM–1:50 PM (S)

52. Transforming Growth Factor-B2 and Chondroitin Sulfate Proteogllycan in Human CSF, but not Transforming Growth Factor-B1, Correlate with Hydrocephalus in Infants

Richard C Krueger, Jr , MD (Los Angeles, CA), Moise Danielpour, MD (Los Angeles, CA), Lily Chow, MD (Los Angeles, CA).

1:50 PM–2:00 PM (H)

53. Neuronal Degeneration and the Role of Ischemic Pre-conditioning in Experimental Hydrocephalus

Janet M. Miller, BS (Detroit, MI), Yuchuan Ding, MD, PhD (Detroit, MI), Alexa I. Canady, MD (Detroit, MI), Pat McAllister, PhD (Detroit, MI).

2:00 PM–2:10 PM (S)

54. Development of a Health Status Outcome Measure for Children with Hydrocephalus

Abhaya V. Kulkarni, MD, M.Sc. (Toronto, Ontario, Canada), James M. Drake, FRCS(C) (Toronto, Ontario, Canada), Doron Rabin, BSc (Toronto, Ontario, Canada), Peter B. Dirks, FRCS(C) (Toronto, Ontario, Canada), Robin P. Humphreys, FRCS(C) (Toronto, Ontario, Canada), James T. Rutka, FRCS(C) (Toronto, Ontario, Canada).

2:10 PM–2:20 PM (H)

55. Prognostic Factors Associated with Cerebrospinal Fluid Shunt Survival Premature Infants

Timothy M. George, MD (Durham, NC), Ketan R Bulsara, MD (Durham, NC), Peter Grossi, (Durham, NC), Matthew J. McGirt, BS (Durham, NC), Fuchs E. Herbert, MD (Durham, NC)

2:20 PM–2:30 PM (H)

56.Cerebrospinal Fluid Shunt Survival and Etiology of Failures: A Seven Y Institutional Experience

Matthew J McGirt, BS (Durham, NC), Alan T Villavicencio, MD (Durham, NC), J.C. Leveque (Durham, NC), John C Wellons, MD (Durham, NC), Herbert Fuchs, MD (Durham, NC), Tim George, MD (Durham, NC).

2:30 PM–2:40 PM

57.Prolonged Intracranial Pressure Recording in Children with Temporal Arachnoid Cysts

Concezio DiRocco, MD (Rome, Italy), M. Caldarelli, (Rome, Italy), A Iannelli, (Rome, Italy), G. Tamburrini, (Rome, Italy).

2:40 PM–2:50 PM

58. Intra Operative MRI Assisted Ventricular Catheter Placement

Zeev T. Feldman, MD (Tel Hashomer, Israel), Moshe Hadani, MD (Tel Hashomer, Israel).

2:50 PM–3:00 PM

59. Slit-Ventricle Syndrome Symptom Resolution Through Incremental Pre Adjustments

Samer K. Elbabaa, MD (Cleveland, OH), Jennifer Ahl, RN (Cleveland, OH), Mark G. Luciano, MD, PhD (Cleveland, OH).

3:00 PM–3:10 PM (H)

60. Prospective Multicenter Shunt Survival Study in the Treatment of Pedia Hydrocephalus Using a Flow Regulating Device. (The European OSV II Stu

Patrick W. Hanlo, MD (Utrecht,), Giuseppe Cinalli, MD (Paris, France,), Peter W. Vanderto (Amsterdam, The Netherlands), Joop AJ Faber, M.Sc. (Utrecht, The Netherlands), Christian Sainte-Rose, MD (Paris, France).

3:10 PM–3:20 PM

61. Ahmed Valve: Flow Rate Analysis

Jeffrey E. Catrambone, MD (Indianapolis, IN), Joel C. Boaz, MD (Indianapolis, IN), Jodi L. Smith, MD, PhD (Indianapolis, IN), Thomas G. Luerssen, MD (Indianapolis, IN).

3:20 PM–3:30 PM

62. Is My Shunt Revision Rate Lower Than Yours?

John H. Honeycutt, MD (Memphis, TN), Stephanie L. Einhaus, MD (Memphis, TN), Regan F. (Memphis, TN), W. V. Shappley, III, (Memphis, TN), Robert A. Sanford, MD (Memphis, TN).

3:30 PM–4:00 PM

Beverage Break with Exhibits and Poster Viewing

4:00 PM–6:00 PM

Scientific Session X—Hydrocephalus

Moderators: A. Parent, MD; J. Wisoff, MD

Learning Objectives:

1. Recognize current treatment for childhood hydrocephalus.
2. Recognize current research trends for childhood hydrocephalus.

4:00 PM–4:10 PM

63. Molecular Approaches to Understanding Hydrocephalus: The Future

Fran W. Morgan, PhD (Orlando, FL), Timothy Morris, BS (Orlando, FL), Jogi V. Pattisapu, MD (Orlando, FL).

4:10 PM–4:20 PM (H)

64. Choroid Plexectomy Eliminates Re-operation, Neurosurgical Re-admission, and Further Neurosurgical Intervention in Patients with Hydranencephaly when Compared with CSF Diversion

John C. Wellons, MD (Birmingham, AL), R. Shane Tubbs, S.A. (Birmingham, AL), J.C. Leveque, MD (Durham, NC), Jeffrey P. Blount, MD (Birmingham, AL), W. Jerry Oakes, MD (Birmingham, AL).

4:20 PM–4:30 PM (H)

65.Treatment of Hydrocephalus Using a Choroid Plexus Specific Immunotoxin: An In Vitro Study

Jake Timothy, FRCS (Leeds, UK), Ewan Morrison, PhD (Leeds, UK), Aruna Chakrabarty, FRCPath (Leeds, UK), James M. Drake, FRCSC (Toronto, Canada), Paul D. Chumas, FRCS (Leeds, UK).

4:30 PM–4:40 PM

66. Lumboperitoneal Shunts in Children

Harold L. Rekate, MD (Phoenix, AZ), Donna C. Wallace, RNNP (Phoenix, AZ).

4:40 PM–4:50 PM (H)

67. Lumboperitoneal Shunting as a Treatment of Slit Ventricle Syndrome

Hoang N. Le, MD (Chicago, IL), David Frim, MD, PhD (Chicago, IL).

4:50 PM–5:00 PM (S)

68. Stretching and Breaking Characteristics of Cerebrospinal Fluid Shunt Tubing

Daniel J. Tomes, MD (Omaha, NE), Leslie C. Hellbusch, MD (Omaha, NE), L. Russell Alberts, PhD (Omaha, NE).

5:00 PM–5:10 PM

69. An Estimate of the Natural Rate of Shunt Infections

Jeffrey W. Campbell, MD (Charleston, SC), Stephen J. Haines, MD (Charleston, SC).

5:10 PM–5:20 PM (H)

70. Length of Antibiotic Therapy for the Treatment of Shunt Infection

Adam S. Arthur, MD (Salt Lake City, UT), John R.W. Kestle, MD (Salt Lake City, UT).

5:20 PM–5:30 PM

71. Late Shunt Infection: Incidence, Pathogenesis, and Therapeutic Implications

Matthieu Vinchon, MD (Lille, France), Lemaitre Marie-Pierre, MD (Lille, France), Vallé Louis, PhD (Lille, France), Dhellemmes Patrick, MD (Lille, France).

5:30 PM–5:40 PM (H)

72. Sudden Death in Hydrocephalic Children Treated with Endoscopic Third Ventriculostomy

Conor Mallucci, MBBS, FRCS (Liverpool, UK), Paul L. May, MBBS, FRCS, FRCPCH (Liverpool, UK), Mosin Javadpour, MBBS, FRCS (Liverpool, UK), Andrew A.C. Webb, FRCS, FDSRCS (Liverpool, UK).

5:40 PM–5:50 PM

73. Repeat Third Ventriculostomy in Pediatric Patients

Lori K. Phuong, MD (Rochester, MN), Kimberly Schoeberl, RN (Rochester, MN), Corey Raffel, MD, PhD (Rochester, MN).

5:50 PM–6:00 PM

74. Endoscopic Third Ventriculostomy in Patients After Cerebrospinal Fluid Infection and /or Hemorrhage

Shlomi Constantini, MD (Tel Aviv, Israel), V. Slomin, (Tel Aviv, Israel), G. Cinalli, A. Grotenhus, A. Golash, S. Oi, K. Kothbauer, H. Weiner, J. Roth, A. Pierre-Kahn.

Saturday, December 1, 2001

Please Note

Oral Abstracts indicated with an (H) are being considered for the Hydrocephalus Foundation of Northern California Award. And those with an (S) are being considered for The Shulman Memorial Award.

7:00 AM–1:00 PM

Registration

7:00 AM–8:00 AM

Continental Breakfast with Exhibit Viewing

8:00 AM–9:00 AM

Scientific Session XI— Panel Discussion: Trials and Tribulations of Using the MR Scanner in the Operating Room

Moderator: R. Abbott, MD

Panelists: M. Proctor, MD; A. Parent, MD; G. Jallo, MD; S. Constantini, MD; M. Hamilton, MD

8:00 AM–9:00 AM

Panel Discussion: Trials and Tribulations of Using the MR Scanner in the Operating Room

9:00 AM–10:30 AM

Scientific Session XII— Neurological Diseases

Moderators: P. Grabb, MD; M. Handler, MD

Learning Objectives:

1. Assess current treatment practices for childhood neurosurgical diseases.
2. Assess current research trends for childhood neurosurgical diseases.

9:00 AM–9:10 AM

75. Intra-operative MRI and Pediatric Neurosurgery

Thomas M. Moriarty, MD, PhD (Louisville, KY), Todd Vitaz, MD (Louisville, KY), Joseph Christiano, MD (Louisville, KY), Paul Larson, MD (Louisville, KY), Norman Mayer, MD (Louisville, KY), Stephen Hushek, MD (Louisville, KY).

9:10 AM–9:20 AM

76. The Successful Utilization of a Mobile 1.5-Tesla Intra-operative Magnetic Resonance Imaging System During Pediatric Neurosurgical Procedures

Mark G. Hamilton, MDCM, FRCSC (Calgary, Alberta,), Terry Myles, MD, FRCSC (Calgary, Alberta), Taro Kaibara, MD (Calgary, Alberta), Garnette Sutherland, MD, FRCSC (Calgary, Alberta).

9:20 AM–9:30 AM

77. Utility and Safety of Intraoperative Magnetic Resonance Imaging for Pediatric Patients

Mark R. Proctor, MD (Boston, MA), Elizabeth A. Eldredge, MD (Boston, MA), Ferenc A. Jolesz, MD (Boston, MA), Liliana Goumnerova, MD (Boston, MA), R. Michael Scott, MD (Boston, MA), Peter M. Black, MD, PhD (Boston, MA).

9:30 AM–9:40 AM (S)

78. FMRI Demonstrates Residual Eloquent Cortex in Perinatal Stroke: Significance and Implications for Post-Surgical Functional Recovery

Samuel R. Browd, MD, Ph.D. (Salt Lake City, UT), Marion L. Walker, MD (Salt Lake City, UT), Leeza Maron, Ph.D (San Diego, CA), Robin Gilmore, MD (Gainesville, FL), Steve Roper, MD (Gainesville, FL), Christiana Leonard, Ph.D. (Gainesville, FL), Richard Briggs, Ph.D. (Gainesville, FL), Bruce Crosson, Ph.D. (Gainesville, FL), Douglas Brockmeyer, MD (Salt Lake City, UT), John Kestle, MD (Salt Lake City, UT).

9:40 AM–9:50 AM (S)

79. Distance of Motor Cortex from the Coronal Suture as a Function of Patient Age

Dennis J. Rivet, MD (Saint Louis, MO), Jeffrey G. Ojemann, MD (Saint Louis, MO), T.S. Park, MD (Saint Louis, MO).

9:50 AM–10:00 AM

80. Approaches to the Third Ventricle: A Pediatric Surgical Series of 25 Patients

Charles Teo, MD (Sydney, Australia), Peter Nakaji, MD (San Diego, CA).

10:00 AM–10:10 AM

81. Medial Pectoral Nerve Transfer for Reinnervation of the Biceps and Deltoid

Paul A. Grabb, MD (Birmingham, AL), Charlie Law, MD (Birmingham, AL).

10:10 AM–10:20 AM

82. Entrapment Neuropathy Contributing to Dysfunction after Birth Brachial Plexus Injuries

P. David Adelson, MD (Pittsburgh, PA), N. Ake Nystrom, MD (Pittsburgh, PA), Robert Sclabassi, MD (Pittsburgh, PA).

10:20 AM–10:30 AM

83. Pediatric Neurosurgery Fellowship after Forty

Howard J. Silberstein, MD, FACS (Rochester, NY).

10:30 AM–11:00 AM

Beverage Break with Exhibits and Poster Viewing

11:00 AM–1:00 PM

Scientific Session XIII—Congenital Anomalies and Trauma

Moderators: D. Brockmeyer, MD; S. Schneider, MD

Learning Objectives:

1. Evaluate current treatment practices for congenital anomalies and trauma.
2. Evaluate current research trends for congenital anomalies and trauma.

11:00 AM–11:10 AM

84. Endoscopic Approach to Pineal Region Tumors

Bakhtiar Yamini, MD (Chicago, IL), Charles Rubin, MD (Chicago, IL), David M. Frim, MD, PhD (Chicago, IL).

11:10 AM–11:20 AM

85. Craniovertebral Abnormalities in Type VI Mucopolysaccharidosis (Maroteaux-Lamy Syndrome)

Ian D. Kamaly-Asl, FRCS (Manchester, England), John A. Thorne, F.R.C.S. (SN), Mohsen Javadpour, FRCS, David G. Hughes, FRCR, Ed Wraith, FRCPCH, Richard A. Cowie, FRCS (SN).

11:20 AM–11:30 AM

86. Temporal Evolution of Brain Injury in Term Newborns Characterized by Diffusion Tensor Imaging

Robert C. McKinstry, MD, PhD (St. Louis, MO), Jeffrey H. Miller, MD (St. Louis, MO), Amit Mathur, MD (St. Louis, MO), Abraham Z. Snyder, MD, PhD (St. Louis, MO), T. S. Park, MD (St. Louis, MO), Jeffrey J. Neil, MD, PhD (St. Louis, MO).

11:30 AM–11:40 AM (S)

87. Hyperglycemia is a Poor Prognostic Sign in Pediatric Head Injury

Francesco Sala, MD (Verona, Italy), Massimo Miscusi, MD (Verona, Italy), Marianna Manfrini, M (Verona, Italy), Carlo Mazza, MD (Verona, Italy), Luciano Cristofori, MD (Verona, Italy), Albino Bricolo, MD (Verona, Italy).

11:40 AM–11:50 AM

88. Smarter Dummies: Infant Head Injury Mechanism Studies Using Improve Anthropomorphic Modeling

Ann-Christine Duhaime, MD (Philadelphia, PA), Michael T. Prange, PhD (Philadelphia, PA), Cindy Christian, MD (Philadelphia, PA), Susan S. Margulies, PhD (Philadelphia, PA).

11:50 AM–12:00 Noon

89. Folic Acid Supplementation Improves CNS Regeneration and Outcome after Spinal Cord Injury in Rats

Bermans J. Iskandar, MD (Madison, WI), Daniel K. Resnick, MD (Madison, WI), Nithya Hariharan, MD (Madison, WI), Gao Peng, MD (Madison, WI), Nelson Aaron, (Madison, W Johnson Chenara, (Madison, WI), Cechvala F. Cate, (Madison, WI).

12:00 Noon–12:10 PM

90. Clinical Significance of CervicoMedullary Deformity in Chiari II Malformation

Prithvi Narayan, MD (Atlanta, GA), Timothy B. Mapstone, MD (Atlanta, GA), Shane Tubbs, S.A. (Birmingham, AL), Paul A. Grabb, MD (Birmingham, AL), Timothy Frye, MD (Birmingham, AL).

12:10 PM–12:20 PM

91. Guidelines for the Management of Severe Head Injury in Children: Upda

Nathan R. Selden, MD, PhD (Portland, OR), David Adelson, MD (Pittsburgh, PA), Susan Bratton MD (Ann Arbor, MI), Nancy Carney, PhD (Portland, OR), Randall Chesnut, MD (Portland, OR), Hugo duCoudray, PhD (Portland, OR), Brahm Goldstein, MD (Portland, OR), Peter Kochanek, M (Pittsburgh, PA), Helen Miller, MD (Portland, OR), Michael Partington, MD (St. Paul, MI).

12:20 PM–12:30 PM

92. Incidence of Delayed Intracranial Hemorrhage in Children with an Uncomplicated Minor Head Injury

Mark G. Hamilton, MDCM, FRCSC (Calgary, Alberta), Tanya Tran, BSc (Calgary, Alberta), Jennif J. McGuire, BSc, MSc (Calgary, Alberta), Christine Malcolm, BSc (Calgary, Alberta), David W. Johnson, MD, FRCPC (Calgary, Alberta).

12:30 PM–12:40 PM

93. Single Photon Emission Computed Tomography in Mild to Moderate Hea Injury: A Developing Modality

Scott Elton, MD (Columbus, OH), Larry Binkovitz, MD (Columbus, OH), Edward Kosnik, MD (Columbus, OH).

12:40 PM–12:50 PM (S)

94. Management of Traumatic Occipito-Cervical Instability in the Very Young

Saadi Ghatan, MD (Seattle, WA), David W. Newell, MD (Seattle, WA), Jens R. Chapman, MD (Seattle, WA), Soheil K. Mirza, MD (Seattle, WA), Michael S. Grady, MD (Philadelphia, PA), Frederick A. Mann, MD (Seattle, WA), Richard G. Ellenbogen, MD (Seattle, WA).

12:50 PM–1:00 PM

95. Refuting Untenable Mechanisms of Fatal Head Injury and G Force Calculations in the Prosecution of Child Abuse Cases

William Micheal Vise, (Jackson, MS).

1:00 PM – 1:05 PM

Closing Remarks

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ic Head Injury
aly), Marianna Manfrini, MD
MD (Verona, Italy), Albino

n Studies Using Improved
, PhD (Philadelphia, PA),
Philadelphia, PA).

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eformity in Chiari II
D (Atlanta, GA), Shane Tubbs, S.A.
ohy Frye, MD (Birmingham, AL).

Head Injury in Children: Update
, MD (Pittsburgh, PA), Susan Bratton,
Randall Chesnut, MD (Portland, OR),
MD (Portland, OR), Peter Kochanek, MD
Partington, MD (St. Paul, MI).

rhage in Children with an
nya Tran, BSc (Calgary, Alberta), Jennifer
n, BSc (Calgary, Alberta), David W.

graphy in Mild to Moderate Head
olumbus, OH), Edward Kosnik, MD

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Seattle, WA), Jens R. Chapman, MD
S. Grady, MD (Philadelphia, PA),
gen, MD (Seattle, WA).

ead Injury and G Force
Cases

1:00 PM–6:00 PM

Post-meeting Coding Course—Advanced Coding Strategies for Pediatric Neurological Surgeons

Faculty: John Piper, MD

Learning Objective:

1. Apply acquired skills to assess and correctly code complex pediatric case scenarios.

1:00 PM–6:00 PM

Post-meeting Coding Course—"Advanced Coding Strategies for Pediatric Neurological Surgeons"

An advanced coding and reimbursement course for the practicing pediatric neurosurgeon who is interested in expanding his or her knowledge of coding. The seminar will be case study or scenario driven and take attendees through an examination of complex pediatric case coding scenarios. Registrants will have the opportunity to send in specific questions or operative notes prior to the course that will be addressed on site during the seminar.

ORAL ABSTRACTS

1. Craniopharyngioma

Authors: Robert A. Sanford, MD (Memphis, TN); Larry E. Kun, MD (Memphis, TN); Thomas E. Merchant, DO, PhD (Memphis, TN)

INTRODUCTION: To review a single institution's experience in treatment of craniopharyngioma and assess the relative merits of combined modality approach involving limited surgery and irradiation.

METHODS: Thirty pediatric patients (median age 8.6 years) diagnosed between 1984 and 1997 were reviewed and characterized according to treatment course and tumor, and treatment related effects including endocrine, neurologic, and neuropsychometric function. In 1984 after review of world literature the authors were convinced that radical surgery for removal of craniopharyngioma had significant endocrine, neurologic, and neuropsychological morbidity. Patients who progressed after radical surgery and required subsequent irradiation suffered combination effect of both modalities. We established a policy to use limited surgery and radiation whenever feasible.

RESULTS: Patients were grouped according to treatment: radical surgery, radical surgery with subsequent irradiation at the time of failure, and limited surgery and irradiation. Patients treated with surgery alone (n = 7) were operated by a single surgeon (RAS) and included very young children (age < 3 years) or children with small easily accessible tumors. The radical surgery group showed a higher incidence of neurologic and endocrine complications, but had moderate decline in full-scale, verbal, and performance intelligence testing with long term follow up. Patients treated with limited surgery and irradiation (n = 15) experienced mild decline in full-scale, verbal, and performance intelligence testing comparable to that experienced for patients treated with surgery alone. Patients initially managed with attempted surgical removal followed with radiation (n = 8) exhibit the most cognitive morbidity.

CONCLUSIONS: Limited resection combined with radiation therapy results in excellent disease control and the fewest neurologic, ophthalmologic, and endocrine abnormalities. The data demonstrates that the most significant morbidity is seen when there's attempt at radical surgical removal, tumor progression, and subsequent irradiation.

2. Expression of Vascular Endothelial Growth Factor Receptors in CNS and PNS Tumors

Authors: Catherine A. Mazzola, MD (Pittsburgh, PA); Ricky Madhok, MS (Newark, NJ); Leroy Sharer, MD (Newark, NJ); Lucy Cho, MD (Newark, NJ); Allen H. Maniker, MD (Newark, NJ)

INTRODUCTION: Vascular endothelial growth factor receptors (VEGFR) are immunoglobulin-like proteins expressed on the surface of endothelial cells. These receptors bind growth factors which induce endothelial cell mitosis and differentiation. Neovascularization has been associated with increased expression of VEGFR-1 and VEGFR-2. A third VEGFR has recently been characterized. VEGFR-3 is believed to be associated with lymphoid cell lines. Our goals were to analyze various CNS and PNS tumors for VEGFR-1, VEGFR-2 and VEGFR-3 expression.

METHODS: Tumor samples (N = 29) were obtained and immediately frozen. Samples were labeled and stored at 70 degrees below Celsius. Using QIAGEN RNeazy total RNA isolation kits, total RNA was isolated and stored. RNA isolates were then subject to reverse transcription polymerase chain reaction (RT-PCR)using specific primers to VEGFR1-3, and GA-3-PDH as a control. PCR products were analyzed on a 2% agarose gel and stained for visualization with ethidium bromide. Separate samples from these same tumors were also sent to neuropathology. Tumors underwent hematoxylin and eosin staining.

RESULTS: The glioma specimens exhibited variable expression of the three VEGFR (N = 6). The meningioma specimens demonstrated high expression of all three VEGFR (N = 5). All schwannoma specimens (N = 4) expressed all three VEGFR. Neurofibromas, unlike the schwannoma or meningioma specimens, had relatively low levels of VEGFR transcripts detected. All metastatic tumor specimens expressed at least one of the known VEGFR (N = 5).

CONCLUSIONS: The expression of the three VEGFR is demonstrated in several peripheral and central nervous system tumors. The high levels of VEGFR-3 expression were not expected in these types of tumors. Expression of VEGFR has been shown to correlate well with neo-vascularization, and the presence of these receptors may suggest a role for anti-angiogenic chemotherapeutic agents in their treatment.

3. Does Histological Subclassification Have Any Predictive Value for the Long-term Prognosis of Children with Cerebellar Astrocytomas?

Authors: Flemming Gjerris, MD, DSc (Copenhagen, Denmark); Tine Bernhardtsen, MD (Copenhagen, Denmark); Henning Laursen, MD, DSc (Copenhagen, Denmark); Jens Haase, MD (Aalborg, Denmark); Marie Bojsen-Moeller, MD (Aarhus, Denmark)

INTRODUCTION:The cerebellar astrocytoma is the most frequent brain tumour in children and usually has a good prognosis. Several long-term follow-up studies have identified two subtypes of cerebellar astrocytoma with different prognoses. The purpose of the present study was to identify prognostic factors in the survival of children treated for a cerebellar astrocytoma during the 25 year period of 1960 to 1984 in Denmark and to evaluate the reproducibility and prognostic value of neuropathological subclassification systems.

METHODS: A total of 107 children (under 15 years of age) treated for an astrocytoma grade I-II, sited either in the cerebellum or in the 4th ventricle, were evaluated. The previously classified histological specimens were re-graded and reclassified according to three different classification schemes: WHO, Kernohan and Daumas-Duport.

RESULTS: We found an overall survival rate of 86% after a follow-up of 15 - 40 years. The only significant prognostic factors of survival were (a) total removal of the tumour and (b) location of the tumour in the cerebellum proper. No difference in survival could be demonstrated between the subgroups with pilocytic and with fibrillary astrocytoma. We also found identical grading profiles of the Kernohan and WHO classification systems and noted that the Daumas-Duport system had a very limited value as a prognostic tool. Moreover, when we compared the initial histological diagnoses with those made on review we found that the reliability of neuropathological subclassification was low.

CONCLUSIONS: The present investigation of cerebellar astrocytoma did not show any predictive value for the three different histological subclassification systems. We also question the value of neuropathological subclassification of low-grade cerebellar astrocytoma for prognostic purposes.

4. Cerebellar Tumor Resection in Childhood followed by Transient Cerebellar Mutism: An Investigation of Residual Speech Deficits in Long-Term Survivors

Authors: Joelene F. Huber-Okrainec, MSc (A) S-LP (Toronto, Canada); Maureen Dennis, PhD (Toronto, Canada); Kim Bradley, PhD (Toronto, Canada); Brenda J. Spiegler, PhD (Toronto, Canada)

INTRODUCTION: The cerebellum is important for the coordination, modulation and temporal regulation of speech. Following cerebellar tumor resection in childhood, a small percentage of patients develop a transient period of cerebellar mutism. It is not known whether speech deficits persist following transient cerebellar mutism (TCM), and whether motor speech abilities in patients who exhibited TCM differ in the long-term from patients who did not exhibit TCM.

METHODS: Long-term survivors (mean survival 11.4 years, range 5.0-22.2 years) of cerebellar tumors resected in childhood who developed TCM (N = 6) were matched for gender, test age, survival years, age at diagnosis, tumor type and location to survivors who did not exhibit TCM (N = 6), and to age and gender matched controls (N = 6). Videotaped speech samples were analyzed by two speech pathologists for: Ataxic Dysarthria (articulation, prosody and phonation deficits associated with cerebellar lesions), Speech Rate, and Percent Dysfluency (e.g. repetitions and prolongations of sounds and blocks of phonation).

RESULTS: Survivors of resected childhood cerebellar tumors who had TCM had significantly more ataxic dysarthric speech than those without TCM ($p = .0208$) and than controls ($p = .0052$), and significantly slower speech rate than those without TCM ($p = .0009$) and than controls ($p = .0030$). Survivors without TCM did not differ from controls on measures of ataxic dysarthria or speech rate. Survivors who had TCM were significantly more dysfluent than controls ($p = .0140$). While survivors with TCM were more dysfluent than survivors without TCM, this difference did not attain statistical significance. Survivors who did not have TCM were not different from controls on measures of percent dysfluency.

CONCLUSIONS: Childhood cerebellar tumor survivors with TCM showed long-term motor speech deficits that were more severe than controls or survivors without TCM. The data suggests that: 1) TCM does not completely resolve, and 2) ataxic dysarthria and motor speech deficits are chronic, if not permanent, sequelae of TCM.

5. Cytogenetics in Recurrent Ependymoma

Authors: Michael H. Handler, MD (Denver, CO); Josephine Wyatt-Ashmead, MD (Jackson, MS); Julie Fleitz, MD (Denver, CO); Nicholas Foreman, MD (Denver, CO)

INTRODUCTION: Ependymomas are best treated by initial complete surgical resection, yet nevertheless may recur. Recurrent tumors are much more resistent to treatment, and are associated with a worse prognosis. Cytogenetic studies have been useful in assessing prognosis in some tumors, and may be useful in assessing ependymomas.

METHODS: 15 patients were treated at Children's Hospital, Denver with recurrent ependymoma. Of the 15, 7 had a second recurrence, 4 had a third recurrence, 3 had a fourth recurrence, and 1 had a fifth recurrence. The age at original tumor resection ranged from 1.7 years to 14 years [average 5.7 years, with 73% less than 5 years of age]. The male:female ratio was 8:7. Cytogenetic studies were available in 10 of 15.

RESULTS: In 7 of 10, there were complex cytogenetic abnormalities most often involving chromosomes 1, 6, 7, and 22 [including monosomy 22]. In 4 of 10, cytogenetic studies were available in the original tumors as well as their recurrences. Karyotypes showed increasingly complex and unstable cytogenetic abnormalities accompanying tumor progression.

CONCLUSIONS: Cytogenetic abnormalities in ependymomas may indicate the potential for recurrence, and be may useful in assessing prognosis in these tumors. Compex karyotypic progression at the time of recuerrence may correlate with short subsequent survival.

6. Delayed Surgical Resection for Central Nervous System Germ Cell Tumors

Authors: Howard L. Weiner, MD (New York, NY); Roger A. Lichtenbaum, MD (New York, NY); Jeffrey H. Wisoff, MD (New York, NY); Mark Souweidane, MD (New York, NY); Jeffrey N. Bruce, MD (New York, NY); Robert B. Snow, MD (New York, NY); Jonathan L. Finlay, MB, ChB (New York, NY)

INTRODUCTION: Our aim was to determine the value of delayed surgical resection in patients with central nervous system (CNS) germ cell tumors who exhibit less than complete radiographic responses despite declining serum and cerebrospinal fluid tumor markers after initial chemotherapy.

METHODS: We retrospectively analyzed 126 patients enrolled on two international multicenter clinical trials (CNS GCT 1 and 2) for patients with newly diagnosed CNS germ cell tumors. Ten of these patients had undergone delayed surgical resection following at least three cycles of chemotherapy due to evidence of residual radiographic despite declining serum and cerebrospinal fluid levels of alpha-fetoprotein (AFP) and human chorionic gonadotropin (_-HCG).

RESULTS: Eight of these patients had demonstrated non-germinomatous germ cell tumor (GCT) elements at initial diagnosis. In these patients, either serum or CSF tumor markers were initially elevated. Two patients demonstrated pure germinomas with normal levels of serum and CSF tumor markers. Following chemotherapy, radiographic evaluation revealed partial response in seven patients, minor response in one patient and stable disease in two patients. All ten patients had either normal or decreasing levels of serum and CSF tumor markers. At delayed surgical resection, seven of the ten patients underwent gross total resection and three patients underwent subtotal resection of residual tumor masses. Pathology at second look surgery demonstrated three mature teratomas, two immature teratomas, and five with necrotic tissue or scar alone. Seven of the ten patients continue to date without recurrence, with an average follow-up time of 36.9 months (range 3 to 96 months).

CONCLUSIONS: Delayed surgical resection should be encouraged in patients with residual radiographic abnormalities and normalized tumor markers, to avoid unnecessary irradiation or intensified chemotherapy.

7. Multi-agent Neoadjuvant Chemotherapy Followed by Response Dependent Reduced Dose Radiotherapy for Newly Diagnosed Germinoma in Children

Authors: George I. Jallo, MD (New York, NY); Victoria LaMarca, PNP (New York, NY); Linda Velasquez, MS (New York, NY); Karl Kothbauer, MD (New York, NY); Jeff Allen, MD (New York, NY); Joao Siffert, MD (New York, NY)

INTRODUCTION: Germinomas are highly curable tumors with radiotherapy (50 Gy) however children are at progressive cognitive and endocrine dysfunction following this traditional craniospinal radiotherapy (RT) treatment course. The use of pre-radiotherapy neoadjuvant chemotherapy may permit a dose and volume reduction of radiation (30 Gy). Prior clinical trials have produced a 70% complete response rate with single agents.

METHODS: We analyzed our results with multiagent chemotherapy and reduced radiation therapy in children treated from 1998 to 2000. We have enrolled 27 children in our protocol, mean age 11.9 years, with histologically confirmed germinoma and negative markers. There were 19 males and 8 females, with 14 tumors located in the suprasellar region, 9 in pineal and 4 in a disseminated region. All the patients were treated with two cycles of carboplatin and etoposide. The radiation dose was based on disease stage and response to chemotherapy. Children with localized disease received involved field RT and those with disseminated diseases received craniospinal RT.

RESULTS: 21/27 (78%) of the children have had a complete response after the first 2 courses of chemotherapy; 6 children required 4 cycles of chemotherapy. This consisted of 2 additional cycles of cisplatin and cyclophosphamide. Of these 6 patients, 5 had a complete response (CR) post 4 courses, and 1 had a continued partial response (PR) and was treated with full dose RT. 26/27 (96%) of children had a CR following neoadjuvant chemotherapy. The mean followup period is 18 months (range, 8–37 months) for the study group. All children who have been followed for >12 months are free of tumor progression.

CONCLUSIONS: Multi-agent neoadjuvant chemotherapy has increased the complete response rate of germinomas thereby permitting a reduction in the radiotherapy dose. We anticipate continued favorable survival and improvement in long-term cognitive and endocrine function.

8. Synergistic Effect of Genistein and BCNU on Growth Inhibition and Cytotoxicity of Glioblastoma Cells

Authors: David J. Nathan, MD (Burlington, VT); Sami Khoshyomn, MD (Burlington, VT); Gregory C. Manske, BS (Burlington, VT); Turner M. Osler, MD (Burlington, VT); Paul L. Penar, MD (Burlington, VT)

INTRODUCTION: Recent experimental data have shown that dietary soy isoflavones such as genistein can significantly suppress invasiveness and growth of a number of human malignancies. In this study we examined whether genistein, at a concentration typical of plasma levels following soy diet intake, in combination with 1,3-Bis(2-chloroethyl)-1-nitrosourea (BCNU, carmustine) exhibited an additive or synergistic inhibitory effect on the growth of glioblastoma multiforme (GBM) cells.

METHODS: Glioblastoma multiforme cell lines (U87 and C6) were treated with genistein at 4 mM, combined with BCNU (0-50 mM). Monolayer cell growth and cytotoxicity, as measured by colonigenic survival in soft agarose, were then compared in control and drug treated cultures. Presence of apoptosis, using the DNA ladder assay and laser scanning cytometry, was investigated in all cell lines at those concentrations at which an enhancement of antiproliferative effect of BCNU in presence of genistein was observed.

RESULTS: We observed a 32%–41% increase in monolayer growth inhibition and a 28%–42% increase in colony cytotoxicity in the U87 cell line when genistein (4 mM) was added to BCNU in 0-10 mM dose range. When the C6 cell line was used, a 30%–36% increase in monolayer growth inhibition and a 39%–54% increase in colony cytotoxicity was observed in the BCNU dose range of 0-50 mM. All experiments showed a significant increase in growth inhibition and decrease in colonogenic survival (all p-values $< .05$). We were unable to detect apoptosis in any of the lines when genistein was combined with BCNU.

CONCLUSIONS: These results indicate that genistein at typical dietary plasma levels can significantly enhance the antiproliferative and cytotoxic action of BCNU. The implication for treatment of glioblastoma multiforme may be a reduction in the chemotherapeutic dose recommendations of these agents and subsequently a decrease in the risk of treatment sequelae for pediatric patients with glioblastoma multiforme.

9. Optic Nerve Decompression in Fibrous Dysplasia. Technique and Long Term Results

Authors: Derek A. Bruce, MD (Dallas, TX); Kenneth M. Shapiro, MD (Dallas, TX); Dale Swift, MD (Dallas, TX); Jeffrey Fearon, MD (Dallas, TX); Kenneth Salyer, MD (Dallas, TX)

INTRODUCTION: To examine the results of optic nerve decompression using a transorbital craniofacial approach in patients with ethmoid or orbital fibrous dysplasia.

METHODS: 25 patients underwent unilateral or bilateral optic nerve decompression while undergoing resection of orbital, ethmoidal fibrous dysplasia. Mean age 20.3 + 11.6 years (2 years–41 years). 16 patients were under 20 years. The average follow up is 6.5 +3.9 years. 12 patients had some visual abnormality prior to surgery, 13 had normal vision bilaterally. In 9 patients the optic canal was bilaterally involved in a circumferential fashion in 16 patients one nerve was involved in a circumferential fashion and in 1 patient only the inferior half of the optic canal. 8 patients had bilateral decompressions, 8 had the right nerve and 9 the left nerve decompressed.

RESULTS: Visual improvement occurred in 11 patients but was dramatic in only 3. Vision was unchanged in 14. No patient had worsening of vision around the time of surgery. 1 patient with optic atrophy and severe impairment preoperatively went on to slowly lose vision over 5 years. There was 1 infection requiring bone removal. Only 1 patient required a repeat optic nerve decompression but 11 required further surgery for facial remodeling secondary to further growth of the fibrous dysplasia.

CONCLUSIONS: Using a transorbital approach to identify the optic nerve surgical decompression can be safely performed at the same time as tissue resection and craniofacial reconstruction is performed. One or both optic nerves can be decompressed at the same surgical procedure. Once vision is decreased recovery is likely in less than 50% of patients and significant improvement in vision is rare. We recommend that optic nerve decompression be performed via the transorbital route, exposing the nerve from the anterior aspect posteriorly to the intracranial dura reflection, at the time of resection of the mass lesion from the frontal bone orbits and ethmoid regions in those patients with significant, $<50\%$ narrowing of the optic canal regardless of visual status.

10. Rhabdoid Tumors of the Central Nervous System: Clinical, Radiographic and Pathologic Features

Authors: Nicholas C. Bambakidis, MD (Cleveland, OH); Alan R. Cohen, MD (Cleveland, OH)

INTRODUCTION: Rhabdoid tumors of the central nervous system are uncommon malignancies of childhood with an aggressive course and a uniformly fatal outcome. These tumors bear radiographic and histologic similarity to primitive neuroectodermal tumors, with which they are often confused. We report our experience with 8 patients with CNS rhabdoid tumors.

METHODS: The medical records, radiographic images and pathologic files at Rainbow Babies and Childrens Hospital over the previous 6 years were retrospectively reviewed in a search for patients with the diagnosis of CNS rhabdoid tumor.

RESULTS: Eight children underwent surgery for CNS rhabdoid tumor at our institution since 1996, the year this tumor was first defined. There were 7 boys and 1 girl. Median age at presentation was 21 months, and all but 1 patient was under the age of 3 years. Median duration of symptoms was 1 month. Tumors were supratentorial in 3 patients, infratentorial in 3 patients, and in the spinal cord in 2 patients. Three children had multifocal CNS disease at the time of presentation. Six patients underwent radical surgery and two had biopsies. The pathological diagnosis was made by finding variable amounts of rhabdoid cells on light microscopy and immunoreactivity to vimentin and epithelial membrane antigen. All patients received multi-agent chemotherapy, and four received CNS radiation. The outcome was uniformly poor with a median survival of 8.6 months from the time of diagnosis.

CONCLUSIONS: CNS rhabdoid tumors are rare, highly malignant neoplasms that are often mistaken for PNETs. In spite of aggressive therapy, the prognosis remains dismal. The search for effective treatment strategies will require a better understanding of the biology and molecular genetics of this tumor.

11. Medulloblastoma: Treatment and Results in Birmingham Childrens Hospital, (1992–1999)

Authors: Anil Sivasankaran; E.C. Leung; Anthony D. Hockley; Spyros Sgouros; A. Richard Walsh; Michael Stevens; Richard Grundy; David Spooner; Sheila Parkes

INTRODUCTION: In 1993, results of 42 patients treated in the Birmingham Children's Hospital from 1980 to 1991 were reported with an overall survival of 43% at a mean follow up of 3 years (range 0–13) years. Detailed analysis at that time failed to demonstrate the value of chemotherapy and possibly a deterioration in outcome when radiotherapy was delayed.

METHODS: In 1992–1999, 41 patients were treated and their outcome is represented here.

RESULTS: The mean age was 5.89 years (2weeks to 14.1 years) and the mean follow up of 3.8 years (range 0 to 9 years). Following total surgical excision the 5 years survival was 61.3% whilst with sub-total excision the 5 year survival was 40%.Those who received radiotherapy (28 patients) following surgery had an acturial survival of 68% at 5 years compared to those who received none(13 patients) with only a 18% survival. For patients who received chemotherapy(22 patients) after surgical excision the survival was 57% at 5 years compared to 52% for those who received none. The overall survival was 62% at 5 years for those patients who had post-operative combined radiotherapy and chemotherapy and only 48% for the rest who received none.

CONCLUSIONS: These results in our recent series do clearly indicate an improvement over the earlier report, and may reflect the benefit of more radical surgery.

12. Characterization of a Hypoxia-Dependent Replicative Adenovirus for the Treatment of Malignant Brain Tumors

Authors: Prithvi Narayan, MD (Atlanta, GA); Sarojini Devi, BS (Atlanta, GA); Dawn E. Post, PhD (Atlanta, GA); Erwin B. Van Meir, PhD (Atlanta, GA)

INTRODUCTION: The presence of resistant hypoxic cells in human brain tumors limits th overall effectiveness of conventional radiation and chemotherapy. Tumor-specific therapie that target hypoxic cells may enhance tumor control. The hypoxia-inducible factor-1 (HIF-1) mediates transcriptional responses to hypoxia by binding to a hypoxia-inducible enhancer motif (HRE) present within target genes. Using the HIF-1/HRE system, a novel type of oncolytic therapy vector that targets hypoxic tumor cells has been developed.

METHODS: We utilized the HIF-1/HRE system to generate a hypoxia/HIF-1 dependent replicative adenovirus (HYPR-Ad1). A DNA cassette composed of a hypoxia-inducible pro moter upstream of the Adenovirus (Ad) type 5 E1 gene region was introduced into the deleted E1 region of a replication defective Ad vector. Conditional expression of the E1 proteins under hypoxia was confirmed using Western blot analysis. The ability of HYPR-Ad1 to induce cytolysis under hypoxia (1% O2) was examined in cell culture using severa human tumor cell lines and the conditional cytopathic effect (CPE) under hypoxia was cor firmed in these cell lines. The ability of HYPR-Ad1 to reduce the growth of an established tumor was examined using several human tumor xenografts implanted subcutaneously in immunocompromised nu/nu mice. Tumor growth was monitored over a period of 10 weeks after which all the animals were sacrificed. The tumors were dissected and the aver age weight of the tumors injected with HYPR-Ad1 versus controls was determined.

RESULTS: There was a significant reduction in the size of tumors injected with HYPR-Ad1 as compared to controls in these initial experiments.

CONCLUSIONS: These preliminary results are consistent with the hypothesis that HYPR-Ad1 reduces tumor growth by specifically causing cytolysis of infected hypoxic tumor cells. Further experiments, on a larger scale, are currently under way to further characterize these results in several brain tumor cell lines.

13. Convection-Enhanced Delivery into the Rat Brain Stem: A Potential Delivery Mechanism for the Treatment of Diffuse Pontine Gliomas

Authors: David I. Sandberg, MD (New York, NY); Mark A. Edgar, MD (New York, NY); Mark M. Souweidane, MD (New York, NY)

INTRODUCTION: Convection-enhanced delivery (CED) can safely achieve high local infusate concentrations within the brain and spinal cord. CED in the brain stem has not been previously reported and may offer an alternative method for treating diffuse pontine gliomas. CED within the rat brain stem was performed to assess safety and establish distribution parameters.

METHODS: Eighteen rats underwent stereotactic cannula placement into the pontine nucleus oralis (PnO) without subsequent infusions. Twenty rats underwent stereotactic can nula placement followed by infusion of fluorescein isothiocyanate (FITC)-dextran at a constant rate (0.1 microliters/min.) to various total infusion volumes ([Vi]; 0.5, 1, 2, 4 microliters). Ten additional rats underwent FITC-dextran infusion (Vi = 4 microliters) and were observed for 48 hours (n = 5) or 14 days (n = 5). Five rats received an intraperitoneal injection of 20% mannitol prior to FITC-dextran (Vi = 1 microliter) infusion, and 5 rats underwent co-infusion of FITC-dextran in 20% mannitol (Vi = 1 microliter). Serial brain sections (20 mm) were imaged using confocal microscopy with ultraviolet illumination, and distribution volume (Vd) was calculated by computer image analysis. Histologic analysis was performed on adjacent sections.

RESULTS: No animal demonstrated a postoperative neurological deficit or histologic evidence of tissue disruption. Vd increased linearly (range 15.4 to 55.8 mm3) with increasing Vi, with statistically significant correlations for all groups compared ($p < .022$). Vd/Vi ratio ranged from 14.0 to 30.9. Maximal cross-sectional area of fluorescence (range 9.8 to 20.9 mm2) and cranio-caudal extent of fluorescence (range 2.8 to 5.0 mm) increased with increasing Vi. Neither IP mannitol nor co-infusion of mannitol caused statistically significant differences in distribution parameters.

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CONCLUSIONS: CED can be safely applied in the rat brain stem with substantial and predictable distribution volumes. This study provides the basis for investigating delivery of various candidate agents for the treatment of diffuse pontine gliomas.

14. Spontaneous Regression of a Diffuse Brain Stem Lesion in the Neonate: Report of Two Cases & Review of the Literature

Authors: Willard D. Thompson, MD (Columbus, OH); Ed Kosnik, MD (Columbus, OH)

INTRODUCTION: Objective and Importance: Diffuse brain stem lesions typically have a grave prognosis despite treatment. We report two unique cases of a diffuse brain stem lesion in a neonate regressing without any treatment. Management implications are discussed and the literature reviewed.

METHODS: Clinical Presentation: Two newborns presented with cranial nerve palsies and limb weakness at birth. MRI obtained in the first week of life revealed a large, expansive pontomedullary lesion in both patients. No hydrocephalus was observed. Clinical and imaging characteristics were highly consistent with a diffuse brain stem glioma.

RESULTS: Intervention: After thorough discussion of treatment options with the patientís parents, all parties agreed it was reasonable to forego any treatment modality. Both were followed with routine neurological exams and MRI imaging. Patient 1 started to clinically improve within weeks and now at 3 * years old has reached all developmental milestones. Serial MRI scans showed a steady decrease in the size of the lesion to a near complete radiological resolution. Patient 2 had a very similar çlinical and radiographic course and is now 9 * yēars old.

CONCLUSIONS: Families and clinicians should be encouraged that a subcategory of diffuse brain stem lesions with good clinical outcome exists, particularly within the neonatal period. Further, these cases support the view that observation alone maybe the best management in this subcategory of patients.

15. Application of the Orbito-cranial Approach in Pediatric Neurosurgery

Authors: Shlomi Constantini, MD MSc (Tel-Aviv, Israel); Vitaly Siomin, MD, (Tel-Aviv, Israel); Sergey Spektor, MD (Tel-Aviv, Israel); Liana Beni-Adani, MD (Tel-Aviv, Israel)

INTRODUCTION: This study evaluates the benefits and indications for the orbito-cranial approach (OCA) in pediatric patients.

METHODS: The authors report their recent experience with the use of OCA in 9 pediatric patients, 6 male and 3 female. The ages ranged from 3 to 17 years (mean 9.6–b5.16 years). Follow-up period extended from 6 to 21 months (mean 12.6–b5.9 months).

RESULTS: Five patients were operated on for craniopharyngiomas, two for chiasmatic-hypothalamic astrocytomas, one for a recurrent hypothalamic gangliocytoma, and one for a hypothalamic hamartoma. In 7 cases a neuronavigation system (BrainLab) was utilized. The lesions were removed totally in 5 patients, near totally in 1, subtotally in 2, and partially in 1 patient. An average of 30% increase in the area of vertical exposure significantly decreased the need for brain retraction. There was no mortality in this series. The only complications related to the surgical approach were transient subgaleal cerebro-spinal fluid (CSF) collections in 7 of 9 children and a subgaleal-peritoneal shunt placement in another patient.

CONCLUSIONS: The experience with this series of patients suggests that OCA is as safe and beneficial in pediatric patients as in adults. It facilitates tumor removal by providing a shorter access and a better exposure of the suprasellar area, thereby minimizing brain retraction.

16. Spinal Cord Mapping as an Adjunct for Resection of Intramedullary Tumors

Authors: Alfredo Quinones-Hinojosa, MD (San Francisco, CA); Russ Lyon, MS (San Francisco, CA); Mittul Gulati, AB (San Francisco, CA); Charles Yingling, PhD (San Francisco, CA); Nalin Gupta, MD, PhD (San Francisco, CA)

INTRODUCTION: Resection of intramedullary spinal cord tumors may result in transient/permanent neurological deficits. Intraoperative somatosensory (SSEPs) and mot evoked potentials (MEPs) are used to limit complications. We used both antidromic-elic SSEPs for planning the myelotomy site, and direct mapping of spinal cord tracts during tumor resection, to reduce the risk of developing neurological deficits, and increase the extent of tumor resection.

METHODS: Two patients, 3 and 12 years of age with tumors of the thoracic and cervica spine, had antidromic-elicited SSEPs by stimulating the dorsal columns and recording w subdermal electrodes at the medial malleoli bilaterally. Intramedullary spinal cord mapp was performed by stimulating the resection cavity using a handheld Ojemann stimulator addition to visual observation, subdermal needle electrodes inserted into the abductor p cis brevis-flexor digiti minimi manus, tibialis anterior-gastrocnemious, and abductor hall cis-abductor digiti minimi pedis muscles bilaterally recorded stimuli that identified moto pathways.

RESULTS: The midline of the spinal cord was anatomically identified by visualizing branches of the dorsal medullary vein penetrating the median sulcus. Antidromic responses were obtained at 1-mm intervals on either side of the midline and the regio where no responses were elicited was selected for the myelotomy. The anatomic and electrical midlines did not precisely overlap. Stimulation of abnormal tissue within the tumor did not elicit EMG activity. Approaching the periphery of the tumor, stimulation 1 mA elicited an EMG response before normal spinal cord was visualized. Restimulati at lower currents using 0.25 mA increments identified the descending motor tracts adj cent to the tumor. After tumor resection, the tracts were restimulated to confirm functi al integrity. Both patients were discharged within 2 weeks of surgery with minimal net rological deficits.

CONCLUSIONS: Antidromic-elicited SSEPs were important in determining the midline o distorted cord for placement of the myelotomy incision. Mapping spinal cord motor tract using direct spinal cord stimulation and EMG recording facilitated the extent of surgical resection.

17. Magnetic Resonance Screening for Occult Pediatric Spinal Intradural Metastases

Authors: Sanjay N. Misra, MD (Dallas, TX); Lynn Gargan, PhD (Dallas, TX); Simpson Georgeanna, (Dallas, TX); Weprin Brad, MD (Dallas, TX); Bruce Derek, MD (Dallas, TX)

INTRODUCTION: The aim of this investigation was to evaluate the frequency of late spin metastases in children with primary brain tumors. Is routine spine screening valuable?

METHODS: All tumor patients at the Children's Medical Center, Dallas were followed from t time of diagnosis of their primary cerebral tumor. All patients in this report were CSF and ima ing negative for intraspinal disease at the time of diagnosis. All underwent routine spine MR studies as part of the follow up protocol. The nature of these tumors and the time to detection of metastases were reviewed in order to determine the optimum time for screening studies.

RESULTS: Over a fifteen year period (1985–2000), there were 829 patients diagnosed with the tumors included in this study. 24 of these patients who developed spinal intradural metastases, satisfied the criteria for inclusion in this investigation. The male:female ratio was 1:1. The mean age distribution of these patients was 6 years +/-4.3 years (range: 1 year–16 years). Follow up was for a mean of 3.6 +/- 3 years (range: 0.3–12.75 years). The tumors were medulloblastoma/PNET (19),ependymoma(3),pilocytic astrocytoma (2). The mean interval to detection of the metastases was 2.5+/- 2.3 years (range:0.1-8 years). The metastases were located in cervical (3), cervicothoracic (1), thoracic (7), lumbar (7) and complete spine (6). 20/24 patients were diagnosed with concurrent cranial recurrence at the time of the imaging studies. 4/24 patients were found to have isolated spinal recurrent disease. These four recurrences were in patients with medulloblastoma/PNET. The mean interval to detection of the metastases in the group of 24 patients was 2.5+/- 2.3 years (range:0.1–8 years). The interval for the different tumors was medulloblastoma/PNET 0.1–8 years (mean 2.5 years), ependymoma 0.3–7.8 years (mean 3 years), pilocytic astrocytoma 1.3–1.5 years (mean 1.4 years). All patients subsequent to diagnosis underwent adjuvant treatment.

CONCLUSIONS: In this series of pediatric brain tumor patients, intradural spinal metastases occurred in 24 out of 829 patients. Detection was at 2.5 +/- 2.3 years following treatment of the primary cerebral tumor. Isolated spinal recurrence was rare and with the possible exception of medulloblastoma/PNET, routine screening of the spine in asymptomatic patients may be unnecessary.

18. Pediatric Tectal Tumors: The Experience at Children's Hospital, Boston

Authors: Sean M. Lew, MD (Boston, MA); Liliana C. Goumnerova, MD (Boston, MA)

INTRODUCTION: There is growing evidence that tectal plate tumors in children represent a more indolent subset of the pediatric cerebral neoplasms. These lesions are typically associated with non-communicating hydrocephalus, and historically have been subject to a wide variety of treatments. The optimal treatment and natural history of these lesions remain unclear.

METHODS: We present a series of 50 patients with tectal tumors managed at Children's Hospital between 1967 and 2001.

RESULTS: The mean age at initial diagnosis was 8.9 years, ranging from 6 weeks to 27 years. The mean follow-up time was 5.7 years, ranging from 3 months to 24 years. Forty-six of 50 patients (92%) required CSF diversion procedures with indwelling ventricular shunts (54 %) and/or endoscopic third ventriculostomy (48%). Patients were treated with multiple modalities of adjuvant therapy including biopsy/resection (18%), whole brain radiation (8%), stereotactic radiotherapy (14%), and chemotherapy (4%). Most patients (72%) were treated with CSF diversion alone. Radiographic progression was seen in 12 (24%) cases. In eight (16%) of these cases the progression was felt to be clinically significant and the patients were managed with adjuvant therapies. All lesions which were biopsied were consistent with low-grade (fibrillary or pilocytic) astrocytomas.

CONCLUSIONS: Based on these data and that of others, it appears that endoscopic third ventriculostomy alone is a preferred treatment of hydrocephalus in this population with a lower complication rate versus indwelling shunt placement. Given the indolent nature of most of these lesions, adjuvant therapies may be reserved for cases with clear evidence of tumor progression.

19. Germline Mutations of Human Suppressor of Fused Predispose to Medulloblastoma and Gorlin's Syndrome Through Failure to Suppress Sonic Hedgehog and Wnt Signaling

Authors: Michael D. Taylor, MD (Toronto, Canada); David Hogg, MD (Toronto, Canada); Corey Raffel, MD PhD (Rochester, MN); Ling Liu, MD (Toronto, Canada); Todd G. Mainprize, MD (Toronto, Canada); C.C. Hui, PhD (Toronto, Canada); Sharon Chiappa, PhD (Rochester, MN); Steve Scherer, PhD (Toronto, Canda); James T. Rutka, MD PhD (Toronto, Canada)

INTRODUCTION: Familial cancer syndromes predisposing to medulloblastoma include Gorlin's syndrome (Patched mutations causing overactivity of the Sonic Hedgehog (Shh) pathway) and Turcot's syndrome (APC mutations causing overactivity of the Wnt signaling pathway). We present data highly suggesting that germline mutations of a novel tumour suppressor gene, Human Suppressor of Fused (HSUFU) predispose to a variety of developmental anomalies and desmoplastic medulloblastoma due to loss of the ability to suppress both Shh and Wnt signaling.

METHODS: Standard techniques in molecular genetics and molecular biology were used.

RESULTS: We present 3 individuals with desmoplastic medulloblastoma (one of whom ha developmental manifestations of Gorlin's syndrome including hypertelorism and developmental delay) and another patient with classical Gorlin's syndrome, all of whom have germline mutations of HSUFU. We also found somatic truncating mutations of HSUFU in subset of sporadic medulloblastomas. HSUFU mutations in medulloblastoma were accompanied by loss of heterozygosity, highly suggesting that HSUFU acts as a classical tumour suppressor gene. Furthermore, we show by immunoprecipitation westerns, confocal microscopy and luciferase promotor assays that wild type HSUFU can suppress both Shh and Wnt signaling by exporting oncogenic Gli transcription factors (the effectors of Shh signaling) and Beta-catenin (the effector of Wnt signaling) from the nucleus to the cytoplasm where they are inactive. This ability is lost in tumour derived mutants of HSUFU.

CONCLUSIONS: Our data highly suggest that germline mutations of HSUFU predispose t developmental anomalies and desmoplastic medulloblastoma, thus defining the existence and molecular basis for a novel familial cancer syndrome. The finding of somatic mutation and loss of heterozygosity in tumour samples highly suggests that HSUFU is a classical tumour suppressor gene. We suggest that loss of HSUFU is tumourigenic through failure to suppress both Shh and Wnt signaling due to loss of nuclear export of oncogenic transcription factors. By activating both Shh and Wnt signaling, germline mutations of HSUFU are molecular mimics of both Gorlin's and Turcot's syndromes.

20. Brain Tumors in the First Two Years of Life: The CHEO Experience

Authors: Khalid Almusrea, MD (Ottawa, Canada); Michael Vassilyadi, MD (Ottawa, Canada); Enrique C.G. Ventureyra, MD (Ottawa, Canada)

INTRODUCTION: Congenital brain tumors are rare, with an incidence of 1.1 out of 100,000 live and stillborn births.

METHODS: The medical charts of all patients less than two years of age at the Children's Hospital of Eastern Ontario (CHEO) with a diagnosis of brain tumor were retrospectively reviewed.

RESULTS: Between 1974 and 2000, out of 296 children diagnosed with brain tumors, 29 were less than two years of age (10%); five (18%) were definitely congenital, 12 (41%) were probably congenital, and 12 (41%) were possibly congenital. Tumors were more commonly located in the supratentorial compartment (62%). Clinical presentation was usually that of symptoms of increased intracranial pressure, macrocrania, and seizures. The most common tumors were astrocytoma (28%), followed by medulloblastoma and PNET (24%). Tumor surgery was performed in 28 patients; 15 underwent a gross total resection (52%), ten a subtotal resection (34%), two a biopsy (7%), and one died intraoperatively. Perioperative mortality rate was 10%. The morbidity rate was 61%; this included major morbidity in six patients (23%). Eleven patients received chemotherapy (42%) and ten radiation therapy (38%). Fifteen patients were alive as of December 31st, 2000 with a mean follow-up of seven years, seven died between 4 and 24 months of diagnosis, and four have been lost to follow-up.

CONCLUSIONS: Early diagnosis and aggressive surgical management of congenital brain tumors may improve outcome. Gross total resection was the only variable in this study that was predictive of longer survival. Adjuvant therapies have their limitation in this particular age of neuronal development.

21. Developmental Brain Insults and their Effects on the Localization of Speech and Motor Cortex

Authors: Shenandoah Robinson, MD (Cleveland, OH); Monisha Goyal, MD (Cleveland, OH); Tarif Bakdash, MD (Cleveland, OH); Max Wiznitzer, MD (Cleveland, OH); Mark Scher, MD (Cleveland, OH); Barbara Swartz, MD (Cleveland, OH)

INTRODUCTION: Both epileptogenic brain insults and intractable seizures may disrupt development of specialized cortex. To determine whether the timing of insults or the duration of intractable seizures altered functional cortex location, we examined our experience with children undergoing surgery for nonlesional intractable seizures.

METHODS: Medical records for 7 consecutive children who underwent extra-operative monitoring were retrospectively reviewed.

RESULTS: Seven children aged 5–16 years underwent extra-operative monitoring with subdural electrodes. Mean pre-operative seizure duration was 8.2 years. Mapping was limited in a comatose patient with status epilepticus. Three of the other children had seizure onset in infancy, and 3 developed seizures after a defined brain insult at age 3–5 years. Of the four children that had left-sided seizure foci, one child with a prenatal stroke transferred his speech to the right, and a child with left temporal lobe herpes encephalitis at 3 years had no frontal language area found. The other two patients had speech areas equivalent in size and location. Intractable seizures began in infancy in one patient, and at age 6 years in the other; both had a long pre-operative seizure duration. Motor cortex was distributed variably with no clear relationship to the timing of the insult or seizure duration. Mean duration of follow-up was 12.4 months. All patients take 1–2 medications and outcomes are 3 Engel class I, 2 class II, and 2 class III.

CONCLUSIONS: Extra-operative monitoring in children allows mapping of speech and motor cortex as well as localization of seizure foci. Functional cortex was displaced in an unpredictable pattern, suggesting that the use of subdural electrodes can maximize seizure-free outcome while reducing neurologic morbidity.

22. Protective Effect of Hyperbaric Oxygen on Hypoxia-ischemia in Neonatal Rats

Authors: Andrew D. Parent, MD (Jackson, MS); Wei Yin, MD, PhD (Jackson, MS); Ahmed Badr, MD (Jackson, MS); George Mychaskiw, MD (Jackson, MS); John H. Zhang, MD, PhD (Jackson, MS)

INTRODUCTION: Perinatal hypoxic-ischemic brain damage remains a major cause of acute mortality and chronic neurological morbidity in infants and children. We have obtained exciting results as shown in the current study that administration of hyperbaric oxygen (HBO) in rat pups prevented or reversed, partially, brain damages caused by cerebral hypoxia-ischemia.

METHODS: Fifty-three 7-day pups underwent unilateral ligation of the right common carotid artery, followed by systemic hypoxia produced by the inhalation of 8% oxygen for 2.5 hr at 37 degree. Three atmospheres absolute (ATA) HBO for 1 hour was administered at 1 hour or 6 hour after hypoxia.

RESULTS: Morphological changes (gross and histological studies) and brain weights were evaluated 2 weeks after hypoxic insult. Extensive damage to hippocampus and striatum on the ipsilateral side was observed in hypoxia-ischemia pups. Hemisphere weights (g) decreased markedly in the hypoxia-ischemia group (0.743+/-0.084) compared with the sham-operated group (1.029+/-0.029) ($P<0.01$, ANOVA). The percentage brain weight of ipsilateral hemisphere to contralateral hemisphere was reduced in the hypoxia group to 59.2%+/-12% of the sham-operated group ($P<0.01$)(ANOVA). HBO treatment at 1hr and 6 hrs after hypoxia partially but significantly prevented brain damage (0.872+/-0.136 and 0.824+/-0.093, respectively), ($P<0.01$ and $P<0.05$)(ANOVA). HBO, applied at 1 and 6 hours after hypoxia, increased the percentage brain weight (ipsilateral hemisphere/contralateral hemisphere) to 77.6%+/-11.3% and 73.6%+/-10.4%, respectively ($P<0.01$)(ANOVA).

CONCLUSIONS: This is the first report to demonstrate that HBO reduced brain injury in hypoxia-ischemia neonatal rats. HBO might be an extremely important therapy to prevent acute mortality and chronic neurological morbidity in infants and children.

23. Potentially Fatal "Blue Spells" in Patients with Brainstem Dysfunction: A Review of Five Patients

Authors: Donna Wallace, PNP (Phoenix, AZ); Harold Rekate, MD

INTRODUCTION: We describe five patients who have "blue spells" (bradycardia, apnea, and or airway collapse) as a consequence of Chiari I or II Malformation. These blue spells may result from autonomic dysfunction and stimulation of the nucleus of the Vagus Nerv

METHODS: Records of four patients with significant hindbrain herniation were retrospectively reviewed when it was noted that one patient had severe hypoglycemia during an episode of autonomic dysfunction. All of the patients were subsequently monitored during these episodes, and were found to have hyperinsulinemia as well as hypoglycemia, as a result of stimulation of the vagus nerve. These patients, and now one other, have also had episodes of "blue spells" during autonomic dysfunction. Three of the patients had Chiari II Malformations as a result of myelomenigocele, one had a Chiari I related to Pfeiffer's Syndrome, and one had a Chiari I malformation because of Achondroplasia.

RESULTS: Three of the five patients were observed to have bradycardia, apnea, and obstructed airways. All of the above patients required manual recussitation, during the brainstem dysfunctions. All of the episodes occurred after agitation, crying, and possible Co2 retention. One possible explanation for this is...If the children could not be ventilated intravenous or intranasal Midazolam was used to relax the airways.

CONCLUSIONS: Children with severe intermittent brainstem dysfunction, who have functioning shunts and have had chiari decompressions, need to be monitored for potentially lethal "blue spells". Care givers need to be trained in CPR, and should be prepared to provide mechanical ventilation, as well as have a benzodiazapene ready if the child's agitation also prevented ventilation.

24. Management of Prenatally Diagnosed CNS Anomalies

Authors: Ramin J. Javahery, MD (Miami, FL); John Ragheb, MD (Miami, FL); Glenn Morrison, MD (Miami, FL)

INTRODUCTION: Neurosurgeons are commonly asked to counsel mothers diagnosed with structural fetal central nervous system (CNS) anomalies. The problems facing neurosurgeons advising families regarding prognosis and treatment are the limited information the literature and the uncertainty of the fetal imaging with regard to ventriculomegaly (VM) and myelomeningocele (MM).

METHODS: Our experience, from July, 1997 to July, 2001, with in-utero diagnosed CNS anomalies consists of 16 cases (13 with adequate follow-up) of women referred for evaluation based on fetal ultrasound results.

RESULTS: These included 7 cases of VM (1 lost to follow-up), 6 cases of MM, and 3 cases of other anomalies. Of the 6 patients with an initial diagnosis of VM only 1 (aqueductal stenosis) had progressive hydrocephalus requiring a shunt. One case had complete regression with a normal CT scan at birth. The remaining 4 patients had other CNS abnormalities including progressive encephalopathy, lobar holoprosencephaly, Acardi syndrome, and intraventricular hemorrhage. Of the 6 patients referred for MM, 3 met the criteria and were referred for fetal surgery. The remaining 3 had closure of their MM at birth. Five of these patients eventually developed hydrocephalus requiring a shunt with only one having VM diagnosed in-utero.

CONCLUSIONS: Overall, only one of the 6 fetuses referred for VM ultimately required a shunt and 5 of the 6 fetuses with MM required shunts though only 1 of this group had VM on the fetal ultrasound. Therefore, fetal VM may be managed more expectantly given the low correlation with neonatal hydrocephalus and the lack of in utero treatment. This experience reflects the care that is needed in advising families regarding management of CNS anomalies given the problems with interpreting fetal ultrasounds.

25. Ventricular Volume in Hindbrain Hernia (Chiari I) in Children

Authors: Christos Tolias, (Birmingham, UK); Kal Natarajan, (Birmingham, UK); Spyros Sgouros, (Birmingham, UK)

INTRODUCTION: The objective of the study was to investigate the ventricular volumes of children with Chiari I malformation in conjunction with the development of hydrocephalus and/or syringomyelia.

METHODS: Ventricular volumes were measured using segmentation techniques on preoperative MRI scans of 18 children with symptomatic Chiari I malformation (age 3–17 yrs). Patients with Crouzonís syndrome, shunt prior to craniovertebral decompression or recurrent hindbrain hernia were excluded from this study. Results were compared with measurements of 50 normal children of similar age. All children were treated with craniovertebral decompression (CVD) and were assessed for the preoperative presence of syringomyelia (8 children, 44%) and the need for post-CVD ventricular shunting due to symptomatic hydrocephalus (3 children 17%). Statistical comparisons were made using one-way ANOVA.

RESULTS: The mean ventricular volume of the whole group of children with Chiari I malformation was significantly larger than in normal controls (35.5ml v. 22.6ml, $p=0.015$). The presence of syrinx within the Chiari I group was associated with higher ventricular volume, but of no statistical significance (45.8 ml v. 29.2 ml, $p=.38$). Both patients without syrinx and those with had significantly larger ventricles than controls (29.2ml, $p=0.03$ & 45.8 ml, $p=0.005$ respectively). Patients that required ventricular shunting had significantly larger ventricles than those who did not (99.1ml v. 24ml, $p=0.001$), while patients who did not require shunting had volumes similar to normal (24ml v. 22.5 ml, $p=.57$).

CONCLUSIONS: A large proportion of children with Chiari I malformation have normal ventricular volumes. Children with syringomyelia or symptomatic hydrocephalus have higher than normal ventricular volumes, indicating a possible progressive impairment in CSF circulation induced by the hindbrain hernia.

26. Peculiarities in the Very Young Patient with Chiari I Malformation

Authors: Jeremy D.W. Greenlee, MD (Iowa City, IA); David M. Hasan, MD (Iowa City, IA); Kathleen Donovan, ARNP (Iowa City, IA); Arnold H. Menezes, MD (Iowa City, IA)

INTRODUCTION: The entity of hindbrain herniation in the very young child has been poorly described. A retrospective analysis of symptomatic children 5 years of age and younger is presented.

METHODS: Between 1985 and 2001, 29 patients were identified with Chiari I and less than age six. Their records were reviewed for symptoms, signs, radiographic findings, treatment and outcome.

RESULTS: Presenting complaints included head or neck pain worsened by valsalva (31%), swallowing difficulties and/or emesis (28%), gait or motor impairment (21%), sleep apnea or snoring (17%), abnormal movements (14%), sensory disturbances (14%). Failure to thrive, recurrent respiratory infections, and developmental delay were less common. Abnormal swallowing mechanism/pharyngeal response was seen in most children, and three patients under age 3 had undergone fundoplication and/or gastrostomy for dysphagia. Common physical findings included hyperreflexia (45%), scoliosis (28%), and abnormal gag reflex (10%). Vocal cord dysfunction (14%) and syringohydromyelia (48%) were also seen. All but 4 patients were treated surgically at our institution with posterior fossa decompression, duraplasty and cerebellar tonsillar shrinkage. Three patients were followed conservatively and had satisfactory clinical courses. Three patients required re-operation. The remaining patients had improved symptomatology. Scoliosis commonly improved as well.

CONCLUSIONS: We show that children can have variable presentations and symptomatology from Chiari malformation. Similarly, their physical findings can be non-specific. However, the younger children in this series (under age 3) had a higher incidence of swallowing difficulties. Therefore very young children presenting with headaches worsened by valsalva or swallowing difficulties should prompt the clinician to consider Chiari I malformation as a possible etiology.

27. Pseudotumor Cerebri Associated with Treatment for Chiari Malformation Type I

Authors: David M. Frim, MD, PhD (Chicago, IL); Lisa Fagan, MA (Chicago, IL)

INTRODUCTION: The anatomic definition of Chiari Malformation type 1 (CM1) as wel other anomalies associated with CM1 remains under re-examination. We have noted th presence of the pseudotumor cerebri syndrome (PTC) in several CM1 patients treated su cally. In order to more fully understand this association we reviewed a series of patients treated for CM1 to define the prevalence and nature of PTC in CM1 patients.

METHODS: 87 consecutive CM1 patients presenting for surgery and followed for 1 yea postoperatively were evaluated for PTC, as documented by high lumbar CSF pressure in the absence of ventriculomegaly.

RESULTS: 10/87 operative CM1 patients (11%) were found to have PTC during their course: 2 before chiari decompression (1 treated with an LPS, 1 treated with a VPS) and after chiari decompression with duroplasty. The mean maximum measured lumbar CSF pressure was 28.2 cm of water for the group (27.5 for the post-op Chiari patients, 31 for the pre-Chiari PTC patients). All Chiari/PTC patients required treatment for PTC: 8 operatively and 2 maintained on oral diuretics. The common PTC symptoms were head pain, body aches, and balance difficulties; 3 patients had visual complaints. All 8 of the post-Chiari decompression PTC patients remained symptomatic despite treatment and documented normal CSF pressures.

CONCLUSIONS: CM1 and PTC co-exist in a surprising percentage of operative CM1 patients and present with a syndrome that is difficult to treat. The etiology of this associa tion after Chiari decompression is unclear, though perhaps posterior fossa surgery in the setting of abnormal anatomy and CSF flow dynamics contributes to CSF malabsorption a resultant PTC.

28. Leonardo daVinci and Virtual Reality: Esthetic Criteria in Surgery for Craniosynostosis

Authors: Hannes Haberl, MD (Berlin, Germany)

INTRODUCTION: The demands made upon the esthetic results of surgery for craniosyno tosis are increasing in a progressively visual world. Surgical standards, which have been established 30 to 40 years ago, do not provide sufficiently precise criteria to meet these expectations. Purpose of this study was to combine modern technology like 3D-Stereolithography and Virtual Reality and a traditional artistic knowledge about cranial pr portions in planning cranial surgical procedures.

METHODS: Artistic knowledge concerning cranial proportions as fixed in sketches, paint ings and instructions through several centuries has been collected and transformed into a age-related database. These data can be used to find either criteria for an individual surgi cal remodeling or to develop programs using 3D-tools for surgical planning. In a prelimi nary selection of patients suffering from craniosynostosis, the database has been used to plan and perform surgery.

RESULTS: Esthetically satisfying results have been achieved in all cases. Particularly in fron to-orbital remodeling, decision-making was accelerated and the reshaping or displacement of bone fragments was simplified.

CONCLUSIONS: The application of a databank containing artistic and anatomical data concerning cranial proportions improves planing and results of surgery.

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29. Pediatric Alloplastic Resorbable Cranioplasty

Authors: Steven J. Schneider, MD, FACS, FAAP (New Hyde Park, NY)

INTRODUCTION: The repair of skull defects provides protection for the brain, improved cosmesis and potential physiologic benefits. Pediatric cranioplasty must take into account the dynamics process of skull growth, thinner scalp and long-term survival of the construct. Prior techniques usually replacement. Autografts including split calvarium and rib necessitate increased operative times, blood loss and are not always feasible. We have subsequently developed a new technique employing two resorbable alloplastic materials, polylactic acid polymer protective sheeting and hydroxyapatite cement. The combination of the two allows the bone inductive cement to remain protected by the polylactic acid polymer sheeting during ossification and incorporation into the growing skull.

METHODS: We have employed these materials in 31 patients which included 20 pediatrics. Retropective analysis of these cases were performed. Postoperative computerized tomography was obtained in all cases. The size, etiology of defect, materials used and outcome were recorded.

RESULTS: Children ranged from 1.5 years to 16 years and defect size from 2 cm x 2 cm to 15 cm x 15 cm. Excellent cosmesis was obtained in all cases.16 cases employed HAC-PLAP and 4 cases HAC alone. There were 2 complications including one premature resorption and one case of fracture with aseptic reaction both in the HAC alone group. The HAC-PLAP had no complications. 40% less HAC was employed in the HAC-PLAP group. The techniques used for working with these materials as well as the evolution of our current practice will be discussed.

CONCLUSIONS: Cranioplasty utilizing resorbable alloplastic materials can be successfully employed in the pediatric population with low morbidity.

30. Cranial Molding Helmets Following Treatment of Craniosynostosis: Four Year Experience with 268 Helmets

Authors: David F. Jimenez, MD (Columbia, MO); Constance M. Barone, MD (Columbia, MO); Cartwright Cathy, RN (Columbia, MO)

INTRODUCTION: Following correction of craniosynostosis, many patients revert to premorbid abnormal head shapes. We have successfully used customized cranial molding following release of craniosynostosis using endoscopic techniques.

METHODS: Between May 1996 and October 2000, 100 patients with craniosynostosis were treated with 268 helmets following release of stenosed sutures. There were 72 males and 28 females, ages ranging between 2 weeks and 9.5 months with a mean age of 3.8. One week after surgery the patients were molded and fitted in a polypropylene helmet. Due to rapid growth, the patients required refitting of the helmets between 2 and 3 times until they reach 12 months of age, at which time the helmet was discontinued.

RESULTS: In all but 4 cases of sagittal synostosis and 3 cases of coronal synostosis, we managed to obtain full and permanent correction of the abnormal head shape. The helmets were well tolerated by the patients. There were 4 or 5 patients who developed small (0.5 to 1.5) scalp irritations and superficial skin breakdowns related to the use of the helmet. Treatment included removal of the scab and allowing the area to heal by temporarily removing the helmet for several days. No permanent scars were seen. There were no allergic reactions. The cost of the helmet was approximately $760.00.

CONCLUSIONS: Review of our data demonstrated that postoperative molding helmets following release of craniosynostosis can be safely and effectively used to obtain and maintain corrections. Technical details will be described.

31. Mild Trigonocephaly Associated with Clinical Symptoms

Authors: Takeyoshi Shimoji, MD (Okinawa, Japan); Satoshi Shimabukuro, (Okinawa, Japan); Seiichi Sugama, (Tokyo, Japan)

INTRODUCTION: It has been thought that isolated trigonocephaly is rarely associated w clinical symptoms. However a few recent reports have detected a relationship between d opmental delays and trigonocephaly. We have now seen more than 100 cases of the mil isolated trigonocephaly with associated developmental delays and have operated on 70.

METHODS: 51 boys and 19 girls with mild trigonocephaly underwent cranioplasty. Th children had an pre- and post-operative evaluation by a pediatric neurologist which inc ed scoring of their developmental quotient. Pre- and post-operative radiographic studie were available for the children and 80% also had SPECT scans.

RESULTS: All patients had symptoms such as delay in language development, hyperact ty, autistic tendencies and/or motor delay in addition to abnormal facial features charac ized by depressed temples, heel (not keel)-shaped foreheads and slight hypotelorism. T most important finding was a palpable closed metopic suture ridge. Most patients did n show any symptoms till one year of age. Fifteen cases exhibited regression in language. CT, 3D-CT and MRI demonstrated the characteristic findings of the trigonocephaly with any abnormality of the brain. Eighty percent of the cases received SPECT with decrease CBF in the frontal lobes being demonstrated. Cranioplasty of the frontal bone including skull base was carried out in all of the patients. Postoperatively there was some improv ment in clinical symptoms, especially for behavior problems, in almost all patients. Postoperatively, increased CBF in the frontal lobes was seen in 95% of the patients as demonstrated with SPECT.

CONCLUSIONS: It might be postulated that the mild trigonocephaly is frequently assoc ed with developmental delays, and that these symptoms can be improved to some deg after cranioplasty.

32. Novel Technique for Minimally Invasive Correction of Metopic Synostosis

Authors: Soren A. Singel, MD (San Diego, CA); Hal S. Meltzer, MD (San Diego, CA); Ralph Holmes, MD (San Diego, CA); Steven Cohen, MD (San Diego, CA)

INTRODUCTION: We present a novel technique for the correction of metopic synostosis lizing minimally invasive concepts to achieve correction of the fronto-orbital deformity, p vention of intracranial hypertension, and avoidance of intra- and postoperative complicati

METHODS: Utilizing a single small frontal incision overlying the anterior fontanelle, w perform bifrontal cranial osteotomies and a metopic suturectomy. Following bilateral su rior tarsal incisions, supraorbital osteotomies are performed to complete the fronto-orbit expansion. Intracranial epidural endoscopy via the frontal incision ensures preservation dural integrity. Calvarial reconstruction with immediate correction is achieved with absorbable plate fixation. Postoperative cranial banding may be used as needed.

RESULTS: Our preliminary experience with this technique will be discussed. To date, th have been no intra- or postoperative adverse events. Physician and patient satisfaction w the postoperative results have been equal or superior to that of standard surgical correcti

CONCLUSIONS: Our technique for minimally invasive correction of metopic synostosi has yielded favorable preliminary results. Long term follow-up and increased patient ac al will be needed to further assess the safety and efficacy of this approach.

33. Are Lipomyelomeningoceles Always Associated with Tethered Cord Syndrome?

Authors: Shokei Yamada, MD, PhD (Loma Linda, CA); David S. Knierim, MD (Loma Linda, CA); Daniel J. Won, MD (Loma Linda, CA); Santiago J. Figuereo, MD (Loma Linda, CA); Franky Almagud, BS, MS

INTRODUCTION: Lipomyelomeningoceles have been reported in association with tethered cord syndrome. However, surgical results of untethering procedures are variable. The authors' studied oxidative metabolism of the spinal cord to correlate the surgical results with neurological conditions.

METHODS: The patients with lipomyelomeningocele or lipoma, were subjected to the "redox" study of cytochrome a,a3 in the lumbosacral mitochondria before and after untethering procedures. Reflectance spectrophotometry was applied to 35 patients, 14 males and 21 females.

RESULTS: Results from these studies revealed three types of cytochrome a,a3 redox states in these patients. Type 1 patients had mildly reduced states before untethering and normal redox states after untethering. Type 2 patients had moderate or markedly reduced state before untethering and normal states after untethering. Type 3 patients had a markedly reduced state before untethering and a moderately reduced state after. Type 1 redox states were seen in patients with only subtle neurologic signs and symptoms and mild musculoskeletal changes. Typically, these patients showed signs and symptoms that subsided within two weeks of untethering. Type 2 redox states were seen in patients with significant motor, sensory and urinary dysfunction, and/or definite musculoskeletal deformities. These patients experienced dramatic improvement of symptoms within three months of untethering. Type 3 presented with moderate to severe neurologic deficits and musculoskeletal deformities. These patients have shown mild but significant improvements in motor and sensory function but with little or no change in bladder control after untethering.

CONCLUSIONS: The degrees of oxidative shift from the reduced state of cytochrome a,a3 allows for prediction of neurological improvement after surgery. Inadequate recovery, impaired oxidative metabolism and neurological deficits are attributed to neuronal dysgenesis.

34. Outcome Following Reoperations for Tethered Spinal Cords Associated with Closed Neural Tube Defects and Lipomatous Malformations

Authors: Hulda B. Magnadottir, MD, MS (Lebanon, NH); J. Gordon McComb, MD (Los Angeles, CA); Michael L. Levy, MD (Los Angeles, CA)

INTRODUCTION: The most common form of spinal cord tethering associated with closed neural tube defects (NTD) contains various amounts of fat. Debate continues not only regarding the indications for the initial surgery but even more so for reoperation. A retrospective review was undertaken at our institution to gain further knowledge as to the outcome of patients who underwent additional operations for this congenital anomaly.

METHODS: Charts of all patients undergoing surgery for closed NTD's with lipomatous malformations at our hospital during a 10 year period were reviewed. Factors assessed were sex, age at initial operation and reoperation, location and size of the lesion, associated abnormalities, pre- and post-operative neurologic, urologic and orthopedic status; and post-operative complications.

RESULTS: One hundred ninety three patients were identified, 22 requiring reoperation. Eight of 179 (4%) patients requiring reoperation had their initial surgery at our institution and 14 at another facility. Indications for reoperation were deterioration of function in all patients including a combination of increasing neurologic deficit (14), urinary dysfunction (3) and progressive orthopedic abnormalities (11). The size of the lipomatous malformation correlated with the need for reoperation; 15/113 (13%) for 2-9 cm lesions and 9/28 (32%) for lesions >10 cm. No patient with a lesion <1 cm required reoperation. The average age of patients undergoing reoperation was 8.7 years (range 3–18) and average time between operations was 6.4 years (range 1–13 years). Outcomes were as follows: neurologic function—18 stable, 3 improved, 2 deteriorated; urologic function—19 stable, 1 improved, 3 deteriorated; orthopedic function—all remained stable.

CONCLUSIONS: Reoperation appears to stabilize most patients with progressive loss of function. The size of the lesion correlates positively with the need for reoperation. The rate of reoperation was 4% at our institution.

35. Is the Myelomeningocele Placode Normal?—An Immunohistochemical Analysis with Implications for Fetal Surgery

Authors: Timothy M. George, MD (Durham, NC); Thomas J. Cummings, MD (Durham, NC)

INTRODUCTION: Intrauterine myelomeningocele repair has not reliably demonstrated improvements in spinal cord function. We analyzed the structure of the myelomeningo placode using novel developmental markers that identify cellular patterning in normal dal spinal cord. We hypothesize that if the placode retains normal spinal cord patternir and is simply unneurulated, then repair may be effective in preventing secondary injur from the intrauterine environment.

METHODS: Novel immunohistochemical caudal spinal cord markers (H4C4, VIN-IS-53 AC4, NOT, FP3) were used to determine cell patterning in normal caudal spinal cord a filum terminale. Utilizing these developmental markers, along with established structur markers (Such as neurofilament, GFAP, synaptophysin, etc.), the cellular patterns of myelomeningocele placodes were mapped.

RESULTS: The myleomeningocele placodes studied exhibited abnormal patterning alon the dorsoventral and rostrocaudal axes associated with a paucity of maturing neurons. I addition, there was significant inflammatory cell infiltrate, gliosis and fibrosis consistent with secondary injury.

CONCLUSIONS: We have provided an immunohistochemical blue print to identify norm spinal cord based upon cellular patterning and cell identity. This study indicates that the myelomeningocele placode is not simply unneurulated but also has not properly develop This implies that fetal myelomeningocelerepair may help prevent secondary injury, but n not aid in functional neurological recovery due to a lack of proper neural development.

36. Intrauterine Myelomeningocele Repair Reduces the Incidence of Shunt-Dependent Hydrocephalus

Authors: Noel B. Tulipan, MD (Nashville, TN); Leslie N. Sutton, MD (Philadelphia, PA); N. Scott Adzick, MD (Philadelphia, PA); Joseph P. Bruner, MD (Nashville, TN)

INTRODUCTION: Preliminary observations suggest that intrauterine myelomeningocele repair may have its most significant effect on intracranial structures rather than spinal on In particular, the incidence of shunt-dependent hydrocephalus seems to be significantly reduced. However, scepticism has persisted as to whether the apparent reduction in hyd cephalus after IUMR is real. Differences in the incidence of hydrocephalus between IUM and conventionally-treated patients have been attributed to the possible tendency of IUM patients to have lower lesions on average than the average conventionally-treated patient Thus IUMR patients may require fewer shunts simply by virtue of having a lower average lesion level.

METHODS: All patients who had undergone IUMR at either Vanderbilt or CHOP and th attained one year of age were studied. These were compared to a cohort of conventionall treated patients followed at CHOP. Patients were stratified according to level of lesion.

RESULTS: A total of 119 IUMR patients were compared to 189 conventionally treated patients. The overall shunt rate among IUMR patients was 54% at one year of age. This compares to an overall rate of 80% for the conventionally treated patients. Among the sul set of IUMR patients whose lesion level was L4 or lower, whose estimated gestatinal age was less than 25 weeks at the time of surgery, and whose ventricles measured 14mm or less prior to surgery the overall incidence of shunting was 20%(8/40). Among conventionally treated patients with lesions at L4 or lower the incidence was 80%. Even among patients with purely sacral lesions the incidence was 68%.

CONCLUSIONS: We conclude that IUMR significantly reduces the incidence of shunt-dependent hydrocephalus, even when lesion level is taken into account. We additionally conclude that younger fetuses with lower lesion levels and small ventricles at the time of surgery are the most likely to benefit from intrauterine intervention.

37. Discernment of Adipose Versus Nervous Tissue Using a Novel Solvent: A Potential Application in Lipomyelomeningoceles

Authors: Ravish V. Patwardhan, MD (Birmingham, AL); Richard S. Tubbs, PA-C (Birmingham, AL); Robert J. Leonard, PhD (Riverside, CA); David Kelly, MD (Birmingham, AL); Cheryl Killingsworth, DVM (Birmingham, AL); Dennis L Rollins, MS (Birmingham, AL); William M. Smith, PhD (Birmingham, AL); Raymond E. Ideker, MD, PhD (Birmingham, AL); W. Jerry Oakes, MD (Birmingham, AL)

INTRODUCTION: To determine a solvent capable of discerning adipose versus nervous tissue, to aid in surgical separation of the adipose tissue which appears to be visually indistinguishable from nervous tissue.

METHODS: The following component-containing solvents were investigated, both at 25 degrees Celsius and 37 degrees Celsius: beta-carotene, vitamin E, hydrogen peroxide, lipase, protease, hyaluronidase, partially purified collagenase, purified collagenase, trypsin, and trypsin-plus-purified collagenase. Each solvent was applied to a pediatric lipoma to determine gross effects. If a solvent appeared to affect the adipose tissue grossly, functional in-vivo sensory evoked and spontaneous potential studies using that particular solvent were conducted upon the sheep spinal cord, nerve rootlets, and peripheral nerve. Additionally, histological studies were conducted to determine the effect of that solvent upon adipose tissue, spinal cord, myelin, dura, nerve rootlets, and peripheral nerve.

RESULTS: Of all solvents investigated, partially purified collagenase at 37 degrees Celsius (Worthington Biochemical, Type I collagenase (T1C)) was the most successful in grossly altering the consistency and appearance of adipose tissue. This change was readily more apparent over 20 to 30 minutes following application of solvent to the adipose tissue. Solvents not containing T1C did not show appreciable results; purified collagenase plus trypsin did not appear comparable or superior to T1C. No significant histological or functional change was noted in comparing the spinal cord, nerve rootlets, myelin, dura, or peripheral nerve for the T1C-treated or normal (untreated) control groups.

CONCLUSIONS: The application of T1C-collagenase appears an effective solvent for the application during lipomyelomeningocele surgery in the acute setting, and may significantly aid in the safe surgical resection of lipomyelomeningoceles. This technique may be applied towards other indications which require discernment or alteration of adipose versus nervous tissue.

38. Management of Pediatric Intrathecal Baclofen Pump Complications

Authors: David John Yeh, MD (Augusta, GA); Mark R. Lee, MD, PhD (Augusta, GA); Ann Marie Flannery, MD (Augusta, GA); Elizabeth Moberg-Wolff, MD (Augusta, GA); Sandy E. Chernich, PA-C (Augusta, GA); John B. Adams, BS (Augusta, GA)

INTRODUCTION: Intrathecal baclofen (ITB) dispensed by an implanted continuous-infusion pump is an accepted treatment for intractable spasticity in the pediatric population. This includes patients with cerebral palsy, severe orthopedic deformities, and syndromic anomalies. This population is at high risk for developing complications associated with implanted pump hardware, especially since intermittent pump refill via subcutaneous introduction is required.

METHODS: We reviewed our experience with 78 patients over a 3 year period.

RESULTS: Multiple complications were identified including dosing error, infection with or without meningitis, pump displacement, catheter misplacement/displacement or fracture; and lumbar or abdominal wound dehiscence, pseudomeningocele, or cerebrospinal fluid fistula. No mortalities were seen.

CONCLUSIONS: We present practical management strategies for the variety of complications we have encountered with ITB therapy via the continuous-infusion pump.

39. Energy Efficiency of Gait: Rhizotomy and Orthopedic Surgery

Authors: Joseph H. Piatt, MD (Philadelphia, PA); Susan Sienko Thomas, MA (Portland, OR); Cathleen H. Buckon, MS (Portland, OR); Michael D. Aiona, MD (Portland, OR); Michael D. Sussman, MD (Portland, OR)

INTRODUCTION: This study compared the effects of orthopedic surgery and selective sal rhizotomy (SDR) on energy efficiency.

METHODS: Twenty-one children with spastic diplegia at a mean age of 70 months (ra 49–132 months) were evaluated before surgical intervention and at yearly intervals for years afterwards. Fourteen children received SDR, while the remaining 7 received orth dic surgery. Energy consumption testing was performed with a SensorMedics 2900 me bolic cart. Velocity (m/s), oxygen consumption (mlO2/kg), and oxygen cost (mlO2/kg/ were analyzed using two-way repeated measure ANOVAs with linear contrasts.

RESULTS: Within the SDR group velocity ($p = .0001$) and oxygen consumption ($p = .04$ increased between 1 and 2 years post-op. Cost did not change significantly. Within the orthopedic group oxygen cost was reduced ($p = .04$) between pre-op and 1 year. Veloc improved between pre-op and 2 years ($p = .01$) only. Comparison of individual oxygen changes within the SDR group revealed that 71% of the children demonstrated a decre $> .03$ mlO2/kg/m between pre-op and 1 year post-op, with 43% showing decreases between 1 and 2 years post-op. Within the orthopedic group, 71% of the children den strated decreases in oxygen cost at both 1 and 2 years post-op.

CONCLUSIONS: Both SDR and orthopedic surgery increased walking velocity without ducing an equivalent increase in oxygen consumption and thus improved the energy ef ciency of gait. Small numbers and heterogeneity both within and between groups make difficult to determine whether these two surgical interventions impacted the energy effic cy of gait differently; however, both interventions appeared beneficial in view of the pro gressive increases in energy cost over time normally found in children with cerebral pal

40. Changes in Gait at Eight Months After Selective Dorsal Rhizotomy

Authors: Jack R. Engsberg, PhD (St. Louis, MO); Sandy A. Ross, PT, MHS (St. Louis, MO); Joanne Wagner, PT, MS, ATC (St. Louis, MO); T. S. Park, MD (St. Louis, MO)

INTRODUCTION: We compare the effects of selective dorsal rhizotomy (SDR) with in sive physical therapy (PT), intensive PT alone, and standard therapy in subjects with ce bral palsy (CP) on changes in gait.

METHODS: In this semi-randomized prospective study, 53 subjects with spastic diplegi were assigned into 3 groups; SDR group ($n = 18$), PT group ($n = 18$) and CP group ($n = 17$ The mean age for all groups was 8 years. The SDR group underwent SDR and intensive (4 times/week). The PT group had intensive PT only, and the CP group maintained their existing level of PT (0-2 times/week). All subjects with CP were tested initially and 8 mo later. A 3-D gait analysis was conducted to quantify kinematic and linear variables.

RESULTS: Linear data showed significant increases of speed stride length for the SDR g but not for the PT group or the control PT group. The SDR group's speed and stride len were, however, still less than those of age matched able bodied children. Kinematic res showed a significant reduction in the total range of motion for pelvic tilt for the SDR gr but no significant differences for the PT group and the control CP group. Knee flextion the intitial contact was significantly decreased for the SDR group but not for the PT or c trol CP group. The kinematic results for all groups remained significantly different from those without disability for all testing sessions.

CONCLUSIONS: The data showed significantly improved gait for the SDR group compa to the PT and control CP group. The SDR group also made significant gains in gait kinem ics. The data suggest benefical effects of SDR on gait of children with spastic diplegia.

41. Strength and Cocontraction after Rhizotomy for Spastic Diplegia

Authors: Joseph H. Piatt, MD (Philadelphia, PA); Cathleen E. Buckon, MS (Portland, OR); Susan Sienko Thomas, MA (Portland, OR); Gerald E. Harris, PhD (Milwaukee, WI); Michael D. Aiona, MD (Portland, OR); Michael D. Sussman, MD (Portland, OR)

INTRODUCTION: The goal of this study was to determine whether selective dorsal rhizotomy (SDR) caused weakness of voluntary muscle activity. A secondary goal was to document the effect of SDR on agonist-antagonist cocontraction.

METHODS: 10 consecutive, ambulatory children with spastic diplegia subjected to SDR were compared to 8 age-matched control children without neuromuscular disease. Isometric force production, resistance to passive movement, and surface electromyographic activity were measured during movements of the elbow, knee, and ankle. Observations were made pre-op, 6 months post-op, and 12 months post-op. Measurements of strength were normalized for weight and height. Pre-op differences in strength between patients and controls were analyzed by unpaired t-tests. Changes in strength over time in children with spastic diplegia were analyzed using one-way repeated measure ANOVAs with linear contrasts.

RESULTS: Children with spastic diplegia were weaker in knee extension, ankle dorsiflexion, and ankle plantarflexion than controls. There were no significant differences in strength between patients and controls in elbow flexion, elbow extension, and knee flexion. Isometric strength did not increase or decrease significantly following SDR. Cocontraction during knee extension was normalized following SDR, but cocontraction during ankle plantarflexion was unchanged by SDR in the majority of children.

CONCLUSIONS: SDR did not cause a significant decrease in strength in ambulatory children with spastic diplegia. Although cocontraction generally indicates a disturbance of central mechanisms governing motor activity, in some instances it may be a volitional strategy to enhance muscle control.

42. Long-Term Functional Outcome Following Selective Posterior Rhizotomy

Authors: Sandeep Mittal, MD (Montreal, Canada); Jean-Pierre Farmer, MD (Montreal, Canada); Borhan Al-Atassi, BSc (Montreal, Canada); Johanne Gibis, PhT (Montreal, Canada); Kathleen Montpetit, OT (Montreal, Canada); Chantal Poulin, MD (Montreal, Canada); Marie-Andre Cantin, MD (Montreal, Canada); Thierry Benaroch, MD (Montreal, Canada)

INTRODUCTION: Selective posterior rhizotomy is a well-recognized treatment for children with spastic cerebral palsy. Few studies have used quantitative outcome measures to report the surgical results beyond 3 years. The authors analyzed data obtained from the McGill Rhizotomy Database to determine the long-term functional outcome of lumbosacral selective dorsal rhizotomy using intraoperative electrophysiological monitoring.

METHODS: The study population comprised children with spastic CP, who underwent SPR and were evaluated by a multidisciplinary team preoperatively, at 6-months and 1-year postoperatively. Quantitative standardized assessments of lower limb spasticity, range of motion measured goniometrically, muscle strength, and ambulatory function were obtained. Of 93 patients who met the entry criteria for the study, 71 and 49 completed the 3-year and 5-year assessments, respectively.

RESULTS: Statistical analysis demonstrated significant improvement in spasticity, range of motion, and muscle strength at 1-year after SPR. The preoperative, 1-year, and 5-year values for the overall GMFM were 64.6, 70.8, 85.6, respectively. When looking specifically at lower extremity muscle strength, the score increased by 23.2% at 1-year and 158.4% at the 5-year assessment. This was associated with an improved alignment, thus greater stability, as well as increased ability to perform difficult transitional movements. More importantly, all improvements were maintained at 3 year and at 5 year following SPR.

CONCLUSIONS: This study supports that significant improvements in lower limb functional motor outcome is present at 1 year after SPR and persists at 3- and 5-year follow-up. We conclude that SPR using intraoperative electrophysiological stimulation is valuable in achieving a balance between elimination of spasticity and preservation of underlying strength.

43. Comparison of Motor Outcomes After Selective Dorsal Rhizotomy With and Without Preoperative Intensive Physiotherapy in Children with Spastic Diplegic Cerebral Palsy

Authors: Paul Steinbok, MBBS, FRCSC (Vancouver, BC); Kimberley McLeod, PT (Vancouver, BC)

INTRODUCTION: A previous randomized clinical trial compared selective dorsal rhizotomy (SDR) plus postoperative intensive physiotherapy (PT) (Group 1) with intensive physiotherapy alone (Group 2) for children with spastic diplegic cerebral palsy. At the end of the trial, all patients in Group 2 had a SDR, followed by further intensive PT. This study was performed to determine if the additional intensive PT before SDR, as occurred in Group 1, improved long-term motor outcome.

METHODS: Outcomes were compared in two groups: Group 1—no intensive PT before SDR and Group 2—intensive PT before SDR. The primary outcome measure was the GMFM. Lower limb spasticity, range and strength were secondary outcome measures. Baseline assessments had been done for the prior clinical trial. For this study, patients were reassessed by physiotherapists blinded to the treatment group. 13 children in each group were studied at a mean follow up of 53 months.

RESULTS: The mean improvement in GMFM was 10.0 in Group 1 and 10.4 in Group 2 ($p = 0.9$). Improvements in spasticity and range were similar in the 2 groups. There was no significant change in muscle strength in either group.

CONCLUSIONS: It was concluded that additional intensive physiotherapy before SDR did not improve motor outcomes.

44. Complications of Invasive Monitoring Used in Intractable Pediatric Epilepsy

Authors: Scott L Simon, MD (Philadelphia, PA); Albert Telfeian, MD, PhD (Philadelphia, PA); Ann-Christine Duhaime, MD (Philadelphia, PA)

INTRODUCTION: Invasive monitoring for intractable epilepsy is useful when the epileptogenic focus is in question even after an extensive non-invasive pre-surgical evaluation, or when the epileptogenic focus is located in eloquent cortex. This study reviews our experience with invasive monitoring and the complications associated with this technique.

METHODS: Prospectively collected data from children who underwent invasive monitoring at the Children's Hospital of Philadelphia (CHOP) was reviewed. From March 1992 to June 2001, 72 children with intractable epilepsy underwent invasive monitoring as part of their pre-surgical evaluation. In every case subdural strips and grids were used. Depth electrodes, when used, were placed under direct vision, usually in previous resection cavities. The surgical protocol included attempting to effect a watertight dural closure, tunneling the electrodes as far as possible, and cinching the electrode to the skin with U-sutures in every case. Antibiotics (usually cefazolin) were administered during the perioperative period. Every patient had intradural cultures sent during removal of the electrodes.

RESULTS: The mean duration of the monitoring period was 5.9 days. Despite precautions, more than 50% of patients had at least one episode of a CSF leak, usually during seizure episodes or vomiting. CSF leaks were all repaired at the bedside. Of the 72 patients, 3 patients had positive intradural cultures, only one of which had a fever in the post-operative period. Lumbar punctures were performed on all three patients, two of which were negative for infection. One patient was treated with antibiotics for a positive lumbar puncture without long-term consequences. No clinically relevant hemorrhages occurred as a result of the invasive monitoring. One patient did have a transient visual field loss after placement of an occipital grid.

CONCLUSIONS: While CSF leaks are common after invasive monitoring despite precautions, CSF infections are uncommon. Invasive monitoring for intractable epilepsy is generally safe.

45. Intracranial EEG and SISCOM in Localization of Epileptogenic Zone in Pediatric Patients with Intractable Partial Epilepsy

Authors: Nicholas M. Wetjen, MD (Rochester, MN); Gregory D. Cascino, MD (Rochester, MN); Jeffrey R. Buchhalter, MD, PhD (Rochester, MN); Corey Raffel, MD, PhD (Rochester, MN)

INTRODUCTION: To determine the relationship between ictal blood flow alterations identified by using subtraction ictal SPECT co-registered to MRI (SISCOM) and the ictal onset zone as defined by intracranial EEG in pediatric patients with localization related epilepsy.

METHODS: SISCOM images were analyzed in 8 pediatric patients with intractable partial epilepsy who underwent chronic intracranial EEG recordings and epilepsy surgery between 1998–2000. Mean age was 13 years (range, 2–18). MRI revealed one or more pathologic substrates in only 3 patients. All patients underwent intracranial EEG studies using subdural grid electrodes for interictal and ictal recordings. Temporal lobe depth electrodes were implanted in 1 patient. The ictal onset zone as identified by chronic intracranial EEG recording was extratemporal in 7 patients and restricted to the temporal lobe in 1 patient.

RESULTS: SISCOM revealed a localized hyperperfusion alteration in 8 of 8 patients. In all 8 patients the SISCOM findings were concordant with the site of seizure onset. The ictal onset zone was invariably confined to the ictal hyperperfusion zone. All patients underwent surgical treatment for their seizure disorder. Four patients (50%) experienced a worthwhile reduction in seizures (Engle Class I–III) during a follow-up of longer than one year. Three of the 4 patients were rendered seizure free following epilepsy surgery. The mean duration of follow-up was 12 months (Range, 3–29).

CONCLUSIONS: SISCOM may be a reliable indicator of the localization of epileptic brain tissue in pediatric patients with intractable partial epilepsy. The SISCOM-identified hyperperfusion zone may participate in the initiation of seizure activity in selected patients with negative MRI evaluations. This region may serve as a target for the placement of intracranial electrodes in patients with localization related seizures undergoing evaluation for epilepsy surgery.

46. Memory Retrieval Resets Theta Oscillations in Patients Undergoing Invasive Monitoring for Epilepsy

Authors: Joseph R. Madsen, MD (Boston, MA); Daniel S. Rizzuto, (Brandeis University, MA); David Seelig, (Boston, MA); Michael J. Kahana, PhD (Brandeis, MA)

INTRODUCTION: Theta band oscillations have specific regional and temporal ties to memory functions revealed during invasive monitoring in pediatric patients as part of the surgical management of seizures (Kahana et al, Nature 399:781, 1999). Phase relationships have been extensively reported in rodents but not previously in humans. Phase as well as amplitude and frequency analysis may be of value in the localization of memory functions in surgical planning, and was therefore studied in our patients.

METHODS: Testing five patients with chronically implanted electrodes, we were able to directly examine the phase of theta oscillations during Sternberg's working memory task. We recorded from a total of 376 electrodes, and restricted this analysis to those 320 electrodes not involved in seizure onset or early spread. Time frequency analysis and phase determination was made by wavelet analysis, and compared phase just before and after presentation of list items and probes.

RESULTS: Prestimulus phase distributions were not significantly different from a random distribution ($p > 0.5$), whereas phase locking of a highly significant degree ($p < .01$ to $p < 0.0001$)in 33 of the electrodes. These electrodes were predominantly distributed over temporal and frontal sites, including depth contacts within hippocampus.

CONCLUSIONS: Phase relationships in hippocampal theta in rodents, especially phase lock with "place cells" during maze navigation, has demonstrated the importance of this field potential oscillation in memory processes. Phase reset generating coherent signals may be the origin of event related potentials (ERPs) in humans, and may allow a new and distinct method of mapping memory functions in children undergoing evaluation for surgical resection for epilepsy.

47. Surgical Treatment of Temporal Lobe Epilepsy in Pediatric Patients

Authors: Sandeep Mittal, MD (Montreal, Canada); Jose L. Montes, MD (Montreal, Canada); Jean-Pierre Farmer, MD (Montreal, Canada); Jean-Guy Villemure, MD; Bernard Rosenblatt, MD (Montreal, Canada); Frederick Andermann, MD (Montreal,); Andre Olivier, MD, PhD (Montreal, Canada)

INTRODUCTION: Surgery has become an accepted treatment modality for carefully selected patients with focal epilepsy. The goal of this study was to describe the clinical and surgical aspects of a group of pediatric patients suffering from intractable temporal lobe epilepsy.

METHODS: Etiologic, pathologic, and clinical features of possible prognostic significance were studied in 109 children who underwent temporal lobe surgery at the Montreal Neurological Institute and the Montreal Children's Hospital between 1985 and 2000.

RESULTS: The mean age of seizure onset was 5.5 years with duration of epilepsy ranging from 0.1 to 17.6 years. Preoperative MRI identified asymmetry and/or mesial sclerosis in 5 patients, a mass lesion in 40, and no visible abnormalities in the remaining 10 cases. Six patients required invasive monitoring. Anterior temporal resection was performed in 72% of patients, while 20% underwent transcortical selective amygdalo-hippocampectomy. Twenty-three patients required a second surgical intervention. On histology, low-grade tumors were observed in 38% of cases, and sclerosis of mesial structures was confirmed in 58%. Eighty-six percent had an excellent outcome (seizure-free or greater than 90% reduction). A history of early, prolonged febrile seizures was usually associated with good outcome, unless there was additional evidence of extratemporal epilepsy. In the entire series, the presence of secondarily generalized seizures was associated with a poor outcome. There were only temporary complications (1.8% surgical and 3.6% neurological) and no mortality.

CONCLUSIONS: Our experience indicates that successful postsurgical outcomes, especially with mesial temporal lobe sclerosis and lesion-related epilepsies, can be obtained in pediatric patients with minimal complications. Unfavorable outcomes are most likely to occur when epileptiform discharges are bitemporal or multifocal in distribution.

48. Clinical and Seizure Outcome in Pediatric Dysembryoplastic Neuroepithelial Tumor: A Series of 47 Cases

Authors: John Wadley, FRCS (London, UK); Joan Grieve, FRCS (London, UK); William Harkness, FRCS (London, UK); Dominic Thompson, FRCS (London, UK); Brian Harding, FRCPath (London, UK); Richard Hayward, FRCS (London, UK)

INTRODUCTION: Dysembryoplastic Neuroepithelial Tumour (DNT)is a rare and indolent lesion principally causing intractable epilepsy in the young and with a reportedly excellent prognosis even after subtotal resection.

METHODS: Retrospective data collection and analysis of 47 cases of children presenting between 1988 and 2000 and undergoing surgery for DNT at Great Ormond Street between 1990 and 2001. Outcome measures were longitudinal seizure and behavioural outcome, reduction in anticonvulsant medication and results of radiological surveillance.

RESULTS: 25 male and 22 female patients presented at a median age of 5.0 years (3 months-14* years) with seizures in 46/47 cases, principally complex partial type (94%). Neurological deficit was the exception, seen only 2 patients. 76% of lesions were temporal, 49% being in a mesial location. Consistent MR imaging features were characterized with previously unreported tumor growth seen in 4 cases preoperatively and in 4 separate subtotally resected cases postoperatively. Detailed follow up (median 5.4 years) revealed a seizure-free outcome (Engel I) in 87% and improved outcome (Engel II & III) in 13% of the 23 patients who underwent total resection with results of Engel I (40%) and Engel II & III (60%) in the subtotal resection group. 8 patients with recurrent seizures underwent further resective surgery with an Engel I outcome in 5, Engel II & III in 2 and no improvement in 1. Improvement in behaviour was seen in 68% of those affected (40%).

CONCLUSIONS: DNT may be recognised by characteristic clinical and imaging features, although a minority of lesions demonstrate change over time. Resective surgery may be offered to those with intractable seizures with a high expectation of a seizure-free outcome, and although subtotal resection results in poorer control of seizures, re-do surgery may still be worthwhile in the majority in experienced hands. Tumor recurrence is not seen.

49. Corpus Callosotomy and Vagus Nerve Stimulation: Comparison of Results in Children with Refractory Epilepsy

Authors: Nejat Akalan, MD; Pinar Ozisik, MD; Oguz Cataltepe, MD; Dilek Yanlizoglu, MD; Guzide Turanli, MD; Meral Topcu, MD

INTRODUCTION: Corpus callosotomy(CC) and Vagus Nerve Stimulation(VNS) are two techniques aiming to reduce the frequency and secondary generalization of seizures in cases that do not have resectable focus and refractory to drugs. In this study, the results of treatment in two similar groups in terms of age and seizure type are analyzed and compared.

METHODS: A retrospective review of 16 children undergoing CC between 1994 and 1997 and 14 children with VNS implantation since 1997 was performed. Evaluation of the cases including neurodiagnostic work-up, EEG-video monitoring, neuropsychological testing and surgical decision were based on a protocol established by our pediatric epilepsy group. The follow-up and evaluation of results were also done by the same group with a standard protocol.

RESULTS: The mean age of the patients was 7.2 years with the range being 3 to 15 years in the CC group while VNS group had a mean age of 14.7 with a range from 11 to 19 years. Mean follow-up was 28 months for CC group and 11 months for the VNS group. The evaluation for CC showed satisfactory results in 58% in 1997 dropping to 42% in the year 2000 and unresponsive cases rising from 12,5% to 25, respectively. VNS group had a satisfactory seizure control in 30% at a mean follow-up of 4.5 months raising to 42% at a mean follow-up period of 8 months. Unresponsive cases decreased from 28% to 21 during the same period.

CONCLUSIONS: Both procedures aim a similar group of refractory epilepsy and the satisfactory results decrease in time for CC while the opposite seems to be true for VNS. Although initial results are in favor of VNS implantation, neither the mechanism for the late failure of CC is yet clear nor evidence is apparent for VNS results to be improving in extended follow-up.

50. Vagal Nerve Stimulation in Childhood Epilepsy: The Liverpool and Manchester Experience

Authors: Jim Leggate, FRCS (Manchester, England); Paul L. May, FRCS (Liverpool, England); J.Z. Hussein, FRCS (Manchester, England); Hesham S. Zaki, FRCS (Liverpool, England)

INTRODUCTION: The north west of England is subserved by two neurosurgical units with a combined poulation base of 7.5 million.Vagal nerve stimulator implants have been used in the management of intractable epilepsy and our results represent the experience of the two lead neurosurgeons from both units.

METHODS: 25 children with a mean age of 13.2 range (5–20) who had undergone implantation of VNS for intractable epilepsy were retrospectively studied.The preimplantation seizure frequency ranged from 1 to 80/day with a mean of (10/day). The mean number of Antiepileptic drugs (AED) at the time of implantation was 3. The mean follow up period was 6-60 months mean (30 months).

RESULTS: The efficacy outcomes were the percentage reduction in seizures after VNS implant which ranged from 0–97% mean (40%).The mean number of AED's after VNS implantation was 2. Non response was recorded for 4 patients. There were no patients who became completely free of AED'S, but treatment with AED's was reduced by 35%. There were 2 VNS implants removed due to infection and there were no intolerable side effects reported.

CONCLUSIONS: Our study will show that VNS is effective in the management of intractable epilepsy seen in reduction of seizure frequency and in use of AED'S.

51. Surgical Revascularistion for Occlusive Cerebrovascular Disease in Childhood

Authors: Dominic NP Thompson, FRCS (London, England); Vijaya Ganesan, MRCP (London, England); John Lumley, FRCS (London, England); Brian Neville, MRCP (London, England)

INTRODUCTION: 20% of children who suffer one ischaemic stroke will have a recurrence. Surgical revascularisation is presented as a possible secondary preventative strategy in children with occlusive cerebrovascular disease. We describe our experience.

METHODS: Between 1997 and 2001 surgical revascularisation has been undertaken in 19 children (age 5–16.5 years, median 11 years). Mode of presentation was with acute ischaemic stroke in 12, transient ischaemic attacks (TIA) in 6 and progressive cognitive impairment in 1. All patients have been investigated by means of MRI and MRA. 17 patients underwent conventional angiography. 18/19 patients had areas of cerebral infarction on T2 weighted MRI. 16/19 children had moyamoya syndrome that was unilateral in 3 cases, 2 had unilateral internal carotid artery (ICA) and 1 had severe bilateral ICA stenosis. 17 patients had a cerebral perfusion study using either single positron emission tomography (SPECT) or MR perfusion imaging. All had evidence of hypoperfusion involving uninfarcted brain tissue. Surgical revascularisation was undertaken in 30 hemispheres. Direct STA to distal MCA microvascular anastomosis was possible in 28/30 procedures. An indirect revascularisation procedure was needed in the remaining 2.

RESULTS: 13 patients have been followed up for 6 months or longer (6 months ± 3.3 years, median 1 year. None of the patients have had a further clinical stroke in the revascularised territory. 7 patients have been entirely clinically stable, the frequency of TIA's has been reduced in 4, 2 patients continue to have frequent TIA's. Post operative MRI scans have been performed in 11 patients at least 6 months after surgery, in none have new areas of infarction been revealed.

CONCLUSIONS: Surgical revascularisation may provide a safe and effective treatment in children with haemodynamically mediated cerebral ischaemia. It may be considered in children with moyamoya syndrome as well as those with severe stenosis of the proximal large vessels.

52. Transforming Growth Factor-B2 and Chondroitin Sulfate Proteogllycan in Human CSF, but not Transforming Growth Factor-B1, Correlate with Hydrocephalus in Infants

Authors: Richard C. Krueger, Jr., MD (Los Angeles, CA); Moise Danielpour, MD (Los Angeles, CA); Lily Chow, MD (Los Angeles, CA)

INTRODUCTION: Mechanisms of injury to the developing brain secondary to congenital/acquired hydrocephalus are not well understood. Transforming growth factor-*1 (TGF-*1) has been linked to progressive, post-hemorrhagichydrocephalus in adults and infants. Both TGF-*1 and TGF-*2 upregulate expression of chondroitin sulfate proteoglycans (CSPGs) in the brain, but the role of CSPGs in progression of intraventricular hemorrhage to hydrocephalus have not been studied. We hypothesize that these proteins are abnormally expressed following germinal matrix/intraventricular hemorrhage, may be detected in CSF, and may correlate with hydrocephalus in infants.

METHODS: After informed consent, CSF from patients (pts) obtained for clinical indications was analyzed. [TGF-*1] and [TGF-*2] was quantified using ELISA assay (R & D Systems). After CSF was deglycosylation with chondroitinase ABC and keratanase, [CSPG] was measured by ELISA using an anti-chondroitin sulfate antibody, with purified bovine cartilage CSPG (aggrecan) as a standard.

RESULTS: CSF from 10 pts with hydrocephalus (Hy-CSF) and 30 control pts (Ct-CSF) was analyzed. If multiple samples were obtained from the same pt, only the earliest sample was included in this analysis. [CSPG] in Hy-CSF was 29.0 mcg/ml (IQR = 41 mcg/ml) compared to 0.32 mcg/ml (IQR = 1.5 mcg/ml) in Ct-CSF ($p = 0.0002$). [TGF-*2] in Hy-CSF was 1390 pg/ml (IQR = 3850 pg/ml), compared to 26.8 pg/ml (IQR = 85.6 pg/ml) in Ct-CSF ($p = 0.0001$). [TGF-*1] in Hy-CSF was 254 pg/ml (IQR = 588 pg/ml), compared to 77.4 pg/ml (IQR = 518 pg/ml) in Ct-CSF ($p = 0.47$). [CSPG] and [TGF-*2] in CSF were correlated ($R = 0.68$, $p < .0001$), but not [CSPG] and [TGF-*1] ($R = 0.029$, $p = 0.86$).

CONCLUSIONS: This is the first study to report [CSPG] and [TGF-*2] are increased in CSF of infants with hydrocephalus, and their concentrations are correlated. In contrast to previous studies, we do not find [TGF-*1] to be increased in CSF of infants with hydrocephalus; nor is [TGF-*1] correlatedwith [CSPG]. Additional studies of CSF-CSPGs and TGF-*2 in pts with hydrocephalus are warranted, as they may prove to be useful clinical prognostic tools.

53. Neuronal Degeneration and the Role of Ischemic Pre-conditioning in Experimental Hydrocephalus

Authors: Janet M. Miller, BS (Detroit, MI); Yuchuan Ding, MD, PhD (Detroit, MI); Alexa I. Canady, MD (Detroit, MI); Pat McAllister, PhD (Detroit, MI)

INTRODUCTION: Although the mechanisms responsible for functional impairments during hydrocephalus have not been confirmed, cell death, axon degeneration and cerebral ischemia may play important roles. This study sought to determine the extent of neuronal degeneration during hydrocephalus, and to test the possibility that ischemic preconditioning during hydrocephalus might produce tolerance to subsequent episodes of ischemia.

METHODS: Neuronal damage visualized by silver staining and immunohistochemistry was compared in 3 groups: young adult rats in which obstructive hydrocephalus was induced by kaolin injection into the cisterna magna, non-hydrocephalic animals with acute forebrain ischemia induced by four-vessel occlusion followed by 2 days of reperfusion, and young adult rats with chronic (8–12 week) kaolin-induced hydrocephalus subjected to the same ischemia/ reperfusion.

RESULTS: In mild or moderate hydrocephalus, little cell death was found, but silver-labeled axons were scattered in the periventricular white matter, corpus callosum and hippocampus. In severe hydrocephalus, cell death was rare but extensive axon degeneration was found in corpus callosum, periventricular white matter, cortical layers IV-VI, subiculum and fimbria. Although some neuron degeneration was found after acute forebrain ischemia in hydrocephalic rats, the extensive cell death in cortical layers III and V and in hippocampal areas CA1 and CA4 that is commonly observed in the ischemic brain without hydrocephalus was not seen.

CONCLUSIONS: These results confirm that axon degeneration is a major pathological feature of hydrocephalus, and is correlated with enlargement of the cerebral ventricles. The lack of neuron death after acute forebrain ischemia suggests that neuronal tolerance to subsequent severe ischemia might occur during hydrocephalus. This newly-discovered response could play a major role in the cellular vulnerability to repeated shunt malfunction.

54. Development of a Health Status Outcome Measure for Children with Hydrocephalus

Authors: Abhaya V. Kulkarni, MD, MSc (Toronto, Ontario); James M. Drake, FRCS(C) (Toronto, Ontario); Doron Rabin, BSc (Toronto, Ontario); Peter B. Dirks, FRCS(C) (Toronto, Ontario); Robin P. Humphreys, FRCS(C) (Toronto, Ontario); James T. Rutka, FRCS(C) (Toronto, Ontario)

INTRODUCTION: The measurement of clinical outcome in pediatric hydrocephalus frequently ignores the substantial effect that the condition can have on a child's physical, emotional, cognitive and social health. Therefore, we developed the first health status outcome measure (HSOM) designed specifically for children with hydrocephalus. This was designed as a simple questionnaire to be completed by the children's parents.

METHODS: The standardized steps in the development of a HSOM were followed. Item generation involved health professionals and focus groups with parents of children with hydrocephalus. This created a comprehensive list of 187 unique health status items. To reduce this list, questionnaires were sent to 70 sets of parents to assess what they felt were the most important of these health issues. The 53 most important items were then selected to represent the following health domains: physical, social, emotional and cognitive. The 53-item questionnaire was then tested for reliability and construct validity, in another cohort of 75 sets of parents, against the following independent measures of specific components of health: Health Utilities Index (HUI-2), Wide Range Achievement Reading Test (WRAT), Strengths and Difficulties Questionnaires (SDQ), Impact-on-Family Scale (IFS), Functional Independence Measure for Children (WeeFIM), and global health ratings by surgeons (GHRS).

RESULTS: The multidimensional 53-item HSOM took approximately 10-15 minutes for t parents to complete and demonstrated excellent test-retest reliability (0.91, 95% confidence interval (CI) 0.85-0.96), inter-rater reliability (0.87, 95% CI 0.76-0.93), and interna consistency (Cronbach's alpha 0.94). Construct validity was demonstrated by very good Pearson correlations of domain scores with their respective independent measures: HUI- (0.81), WRAT (0.58), SDQ (0.70), IFS (0.55), WeeFIM (0.88), GHRS (0.68).

CONCLUSIONS: A HSOM for children with hydrocephalus has been developed and has demonstrated excellent reliability and validity properties. This will provide a valuable outcon measurement tool for a wide range of clinical research projects in pediatric hydrocephalus.

55. Prognostic Factors Associated with Cerebrospinal Fluid Shunt Survival in Premature Infants

Authors: Ketan R. Bulsara, MD (Durham, NC); Peter Grossi, BS (Durham, NC); Matthew J. McGirt, BS (Durham, NC); Fuchs E. Herbert, MD (Durham, NC); George M. Timothy, MD (Durham, NC)

INTRODUCTION: Cerebrospinal fluid (CSF) shunts are associated with a high rate of failure when placed in premature neonates. Identification of poor shunting candidates may improve the management of hydrocephalus in this patient population. The purpose of this study was to identify prognostic factors associated with early shunt failure in premature neonates.

METHODS: We retrospectively reviewed the records of all premature neonates (gestational age <36 weeks) who underwent shunt placement for hydrocephalus between January 199 and December 1997. Gestational age, etiology of hydrocephalus (intraventricular hemorrhage (IVH) versus congenital), time from birth to shunt surgery, neonate weight at surgery, head circumference, and preoperative CSF protein level were recorded. Kaplan Meier (shun survival) curves and log rank analysis were used to compare subgroup shunt survival.

RESULTS: Twenty-eight premature neonates underwent shunt placement for hydrocephalus. Mean gestational age was 29 weeks (range, 25-36). PS medical valves were used in all cases. Increased preoperative CSF protein levels (>130 vs <130 mg/100ml) were associated with worse shunt survival (6mo, 25% vs 65%, $p<0.05$). Duration from birth to surgery, weight at surgery, gestational age, IVH versus congenital hydrocephalus, and head circumference were not associated with subsequent shunt survival.

CONCLUSIONS: CSF protein levels greater than 130mg/100ml may identify premature neonates that are predisposed to CSF shunt failure. This data may have important clinical implications in the management of premature neonates with hydrocephalus.

56. Cerebrospinal Fluid Shunt Survival and Etiology of Failures: A Seven Year Institutional Experience

Authors: Matthew J. McGirt, BS (Durham, NC); Alan T. Villavicencio, MD (Durham, NC); J.C. Leveque, MD (Durham, NC); John C. Wellons, MD (Durham, NC); Herbert Fuchs, MD (Durham, NC); Timothy George, MD (Durham, NC)

INTRODUCTION: The last decade of innovations in shunt technology and neuroendoscopy has improved shunt management. However, the relative lifespan of shunts and etiology of shunt failure has not been recently characterized.

METHODS: We reviewed the records of 836 consecutive shunting procedures at our institution between January 1992 and December 1998. Shunt failure rates were compared using Kaplan-Meier (shunt survival curves) and log-rank analysis according to patient age, underlying diagnosis, and new placement versus revision. Cause of shut failure was classified as infection, proximal, and/or distal obstruction and analyzed according to shunt age, underlying diagnosis, patient age, new insertion, or revision (chi squared test).

RESULTS: A total of 353 pediatric patients underwent 308 shunt placements and 528 revisions. There was no difference in shunt survival between placed and revised shunts ($P=0.719$). Shunt survival decreased in younger patients ($p<0.01$). Intraventricular hemorrhage (IVH) was the only underlying diagnosis associated with greater shunt failure, ($p<0.05$). Etiology of failure did not differ between underlying diagnoses, however, the incidence of infection increased in younger patients. Failure from distal obstruction was greater in revised versus newly placed shunts (36% vs. 12%, $P<0.005$) in the first six months after surgery only. The incidence of infection decreased while distal obstruction increased as a function of time.

CONCLUSIONS: Despite the advent of neuroendoscopy, the long term shunt revision rates observed here are similar to those reported over the past two decades. Shunt lifespans vary with patient age and etiology of hydrocephalus, but not between new and revised shunts. Etiology of shunt failure varies as a function of time, patient age, and revision status.

57. Prolonged Intracranial Pressure Recording in Children with Temporal Arachnoid Cysts

Authors: Concezio DiRocco, MD (Rome, Italy); M. Caldarelli, (Rome, Italy); A. Iannelli, (Rome, Italy); G. Tamburrini, (Rome, Italy)

INTRODUCTION: Temporal arachnoid cysts developing within the Sylvian fissure represent a challenging lesion to the neurosurgeon in terms of surgical indication when incidentally detected in asymptomatic children or when recognized in subjects presenting only with mild and a specific clinical symptoms, e.g. headache.

METHODS: In the present report we describe the results obtained in 8 consecutive patients, ranging in age from 15 days to 15 years, who underwent the prolonged recording of their intracranial pressure (ICP) in the Pediatric Neurosurgery Section at the Catholic University Medical School, Rome. Three of the patients here considered harbored a Type I cyst, according to Galassiís classification, 4 Type II and 1 Type III cysts.

RESULTS: Normal ICP levels were recorded in all the children with Type I cyst. The ICP was abnormally elevated in the infant with Type III lesion. Both normal (2 cases) and abnormally high (2 cases) ICP values were observed in the 4 patients with Type II cyst. Consequently, the prolonged ICP recording appears to be a useful surgical indicator in doubtful cases (small or moderate lesions) of temporal arachnoid cysts. However, one patient of this series, with Type I cyst and normal ICP values underwent the iprophylacticî surgical excision of the lesion on request by the parents and subsequently demonstrated a re-expansion of the temporal lobe after the operation.

CONCLUSIONS: Such an observation might suggest a mechanical role of this type of lesion which could be exerted in some children even in the absence of an increased intracranial pressure.

58. Intra Operative MRI Assisted Ventricular Catheter Placement

Authors: Zeev T. Feldman, MD (Tel Hashomer, Israel); Moshe Hadani, MD (Tel Hashomer, Israel)

INTRODUCTION: Improper placement of shunts at the level of the ventricles, remains unacceptably high. In most centers, ventricular catheter placement remains a "blind" procedure. Most methods of assisting the placement of the ventricular catheter increase the complexity of the operation, prolong the operation time and increase the risk of infection. We present a method for placement of the ventricular catheter using an intraoperative MRI guidance system which prolong the anesthesia time but not the operation.

METHODS: The system we used features a MRI scanner integrated with an optical and MRI tracking system. Scanning and navigation, operated by the surgeon, are controlled by an in-room computer workstation with an LCD screen. The scanner is a permanent magnet of 0.12T with a 26cm vertical gap, accommodating the patient's head. The field of view is 11x16 cm, encompassing the surgical area of interest. The magnet is mounted on a transportable gantry that can be positioned under the surgical table when not in use for scanning, so rendering the surgical environment unmodified, allowing the use of standard instruments.

RESULTS: The patients are positioned for shunt placement and a baseline T1 scan is obtained. The integrated navigation features are used for planning the entry point and target of the tip of the ventricular catheter within the ventricles. The patients are then prepped and draped, and a standard procedure for insertion of a v-p shunt is performed. The ventricular catheter is placed using the navigation features of the system. At the end of the procedure a T2 scan along the axis of the ventricular catheter is performed, for immediate verification of the catheter position.

CONCLUSIONS: The use of the intraoperative MRI enables real time planning, navigation and immediate verification of catheter tip position.

59. Slit-Ventricle Syndrome Symptom Resolution Through Incremental Pressure Adjustments

Authors: Samer K. Elbabaa, MD (Cleveland, OH); Jennifer Ahl, RN (Cleveland, OH); Mark G. Luciano, MD, PhD (Cleveland, OH)

INTRODUCTION: Although slit-ventricle syndrome (SVS) is a relatively uncommon diagnosis, it commonly results in multiple shunt revisions. While treatment varies from proximal shunt revision to 3rd ventriculostomy and cranial expansion, valve replacement to increase drainage resistance is often performed. We review our experience with implantation and modulation of adjustable valves for pediatric SVS.

METHODS: Nine patients with clinical/radiological diagnosis of SVS were treated by placement of the Codman adjustable valve. After implantation, valve pressure was adjusted upward in 10–20 mm Hg increments. Medical records and CT scans were reviewed retrospectively.

RESULTS: Nine patients (M/F = 4/5) with a mean age of 9 years (0.5–20 years) were followed for a mean of 4.6 years. The mean time from the first shunt surgery to the development of SVS was 9.5 years. Before adjustable valve placement, the mean number of overdrainage-related revisions was 7 per patient. All patients showed gradual symptom resolution with incremental increase in valve pressure, though in 3 of these a second adjustable valve was required. In 7/9 patients,this improvement was seen without a significant increase in ventricular size.

CONCLUSIONS: The adjustable valve maybe an efficient tool in treating SVS, ultimately decreasing the number of shunt revisions. Gradual postoperative pressure adjustments can lead to clinical relief without correspondent change in the ventricular size.

60. Prospective Multicenter Shunt Survival Study in the Treatment of Pediatric Hydrocephalus Using a Flow Regulating Device (The European OSV II Study)

Authors: Patrick W. Hanlo, MD (Utrecht, The Netherlands); Giuseppe Cinalli, MD (Paris, France,); Peter W. Vandertop, MD (Amsterdam, The Netherlands); Joop AJ Faber, MSc (Utrecht, The Netherlands); Christian Sainte-Rose, MD (Paris, France)

INTRODUCTION: To evaluate the long term results of a flow regulating device (Orbis Sigma Valve II, NMT Neurosciences, Sophia Antipolis, France) in the treatment of pediatric hydrocephalus in everyday clinical practice in a prospective multicenter study.

METHODS: Patients with hydrocephalus, age between 0–16 years, with different etiologies, were treated by implanting an OSV II system (mostly ventriculo-peritoneal shunts: 95.2%). The follow up period was three years (range: 0–3). Endpoints were defined as any shunt re-operation resulting from shunt obstruction, overdrainage, or infection and any other shunt related operation. The overall three year shunt survival and the shunt survival in the different subgroups was assessed.

RESULTS: Two-hundred-ninety-one patients were selected for OSV II implantation. 120 (41.2%) patients reached an endpoint. There was no shunt related death. Shunt obstruction occurred in 39 (13.4%), overdrainage in 1 (0.3%), and infection in 23 (7.9%). 71 percent were shunt failure-free at 1 year, 67% at 2 years, and 64% at 3 years after shunt implantation. There was a significant lower shunt survival in children under one year of age at 3 years after shunt implantation (56%). The group under one year of age consisted of 125 children. In this group shunt obstruction occurred in 24 (19%), infection in 12 (9.6%) and no overdrainage.

CONCLUSIONS: In the treatment of hydrocephalus shunt failure due to mechanical complications and infection, remains a persistent problem in the pediatric population. The overall three year survival rate in this study is better compared to other recent shunt studies. The results of this study suggest that implanting a flow regulating device can reduce the incidence of overdrainage in the pediatric population (only 0.3% overdrainage in this study), and thereby improve shunt survival significantly in hydrocephalus treatment.

61. Ahmed Valve: Flow Rate Analysis

Authors: Jeffrey E. Catrambone, MD (Indianapolis, IN); Joel C. Boaz, MD (Indianapolis, IN); Jodi L. Smith, MD, PhD (Indianapolis, IN); Thomas G. Lluerssen, MD (Indianapolis, IN)

INTRODUCTION: Although several valves exist for the treatment of hydrocephalus, there is a need for improved valve perfomance. In our presentation we will demonstrate improved flow characteristics of the Ahmed valve versus the Delta valve system.

METHODS: Using a closed manometer system, we measured pressure (units: inches of water) versus rate (units: ml/ml) comparing the flow characteristics of the Ahmed valve versus the Delta valve system.

RESULTS: The Ahmed valve demonstrates a more consistent and linear relationship of flow versus pressure. Also at higher pressures, the Ahmed valve demonstrates improved flow rates.

CONCLUSIONS: The Ahmed valve, the most popular valve system for the treatment of glaucoma, demonstrates improved flow characteristics to the Delta Valve system.

62. Is My Shunt Revision Rate Lower Than Yours?

Authors: John H. Honeycutt, MD (Memphis, TN); Stephanie L. Einhaus, MD (Memphis, TN); Reganl F. Hill, (Memphis, TN); W.V. Shappley, III, (Memphis, TN); Robert A. Sanford, MD (Memphis, TN)

INTRODUCTION: Through this retrospective study, the shunt revision rate was established for a single group of pediatric neurosurgeons with follow up in one clinic. By outlining our criteria for shunt revision, the authors hope to limit the number of unnecessary shunt revisions.

METHODS: The authors reviewed all medical records of children shunted at LeBonheur Children's Hospital from 1985 through 2000 during the first ten years of life for the purpose of establishing the number of shunt revisions and factors influencing shunt surgery. Follow up ranged from one to 21 years.

RESULTS: Included in the study were 1100 patients who were followed from one year to 31 years of age. During this period of time, the average shunt revision rate was 1.96 revisions per patient, with no child having more than 11 total revisions in 21 years of follow up. As the subject of a previous report, 26 slit ventricle syndrome patients were encountered. (Sanford, R.A., Muhlbauer, M.S., Einhaus, S.L., and Thomas, E: Ten-Year Experience with Slit Ventricle Syndrome in Children. Presented at AANS Annual Meeting April, 1998 in Philadelphia, PA).

CONCLUSIONS: The consistent criteria for shunt revision were signs and symptoms of increased intracranial pressure with changes in ventricular size when baseline scans were available. No patient had a shunt revision for headache alone. The basic premise used is that a shunt is a mechanical device that has a range of normal function. With the onset of malfunction, time becomes the most important factor in determining adequacy of function. Though early signs and symptoms of malfunction are difficult to correctly diagnose, with patience and follow up the shunt malfunction worsens over time and becomes obvious. This study of expectant observation has limited unnecessary revisions and has led to this low revision rate (1.96 per patient). The authors hope that this presentation will engender frank discussion concerning the variability of criteria for shunt revision across the United States and Canada.

63. Molecular Approaches to Understanding Hydrocephalus: The Future

Authors: Fran W. Morgan, PhD (Orlando, FL); Timothy Morris, BS (Orlando, FL); Jogi V. Pattisapu, MD (Orlando, FL)

INTRODUCTION: Hydrocephalus is a multifactorial disorder known to affect infants a young children. It also afflicts older patients, and indeed may occur at any age. It can ensue as a primary disorder or it can be secondary to other systemic conditions, infec or trauma. More importantly, little is yet known regarding the molecular and biochem processes involved in the development of hydrocephalus.

METHODS: The present treatment of using shunt devices to divert the cerebrospinal f to another part of the body was introduced approximately 45 years ago. The shunting indeed revolutionized the management of this condition, however, problems remain many patients require multiple operations to keep the shunts functioning. The identifi of specific molecular and biochemical mechanisms responsible for hydrocephalus wi necessary if improved treatment is to be developed.

RESULTS: Large-scale sequencing efforts have provided sequence data for thousands human genes. Even though many of these genes have been assigned to functional cla the roles they play in various biological processes have yet to be defined. As a first m lar step to understanding the biological mechanisms involved in the condition of hyd cephalus, cDNA expression array technology will be utilized to identify differences ir expression patterns between HTX, normal and hydrocephalic, and Sprague Dawley r This technology will allow the analysis of multiple genes simultaneously. The semiqu tive results generated by the use of cDNA gene array studies will be corroborated usi quantitative RT-PCR techniques.

CONCLUSIONS: Molecular and biochemical techniques applied to the investigation normal versus hydrocephalic biological processes will advance the understanding of cephalus and aid in the discovery of potential therapeutic and diagnostic drug targets

64. Choroid Plexectomy Eliminates Re-operation, Neurosurgical Re-admission, and Further Neurosurgical Intervention in Patients with Hydranencephaly when Compared with CSF Diversion

Authors: John C. Wellons, MD (Birmingham, AL); R. Shane Tubbs, SA (Birmingham, AL); JC Leveque, MD (Durham, NC); Jeffrey P. Blount, MD (Birmingham, AL); W. Jerry Oakes, MD (Birmingham, AL)

INTRODUCTION: Choroid plexus removal from the lateral ventricles was attempted by Dandy in the first quarter of the 20th century but later discarded as complications arose ventriculoperitoneal shunting was introduced. We compare our experience with a varia of this operation to CSF diversion in patients with hydranencephaly or near-hydranence

METHODS: The hospital and office charts from patients with the diagnosis of hydran cephaly were reviewed from the two institutions spanning the career of the senior au Thirteen patients were identified, of which 9 underwent CSF diversionary procedures (Group A) and 4 underwent choroid plexectomy (Group B).

RESULTS: The mean number of re-operations (A:2, B:0), neurosurgical re-admissions (A:1.5, B:0), and hospital days related to neurosurgical re-admissions (A:43.5, B:0) w less in patients who underwent choroid plexectomy. The total incidence of complica related to surgery was also less. (A:7, B:0).

CONCLUSIONS: In our experience, choroid plexectomy in patients with hydranence reduces the incidence of re-operation and re-admission, the number of hospital days ed to the surgical procedure, and the total number of complications in comparison t patients undergoing CSF diversion. Further neurosurgical intervention is minimized a the financial burden from multiple emergency department visits and radiographic pr dures for shunt evaluation. Choroid plexectomy is a viable alternative to CSF diversi patients with hydranencephaly. The chronic issues and complications surrounding C diversion in this difficult group of patients are avoided.

65. Treatment of Hydrocephalus Using a Choroid Plexus Specific Immunotoxin: An In Vitro Study

Authors: Jake Timothy, FRCS (Leeds, UK); Ewan Morrison, PhD (Leeds, UK); Aruna Chakrabarty, FRCPath (Leeds, UK); James M. Drake, FRCSC (Toronto, Canada); Paul D. Chumas, FRCS (Leeds,UK)

INTRODUCTION: Walter Dandy first proposed choroid plexotomy for the treatment of hydrocephalus in 1918. These initial attempts were abandoned due to the high morbidity associated with the procedure. Ventriculo-peritoneal shunts and third ventriculostomies are currently the mainstay of treatment for hydrocephalus but are associated with high revisional surgery and failure. We have revisited the concept of destruction of the choroid plexus for the treatment of hydrocephalus using a novel technique to specifically destroy this tissue.

METHODS: We have characterized both sheep and human choroid plexus cells (including atypical and carcinoma cell lines) using confocal microscopy. Choroid plexus tissue has several epitopes that are specific within the brain and can be used as targets for an immunotoxin. An immunotoxin was manufactured by combining a choroid specific antibody to Ricin A-chain, which is a toxin. The production was assessed by a SDS-PAGE gel and removal of free ricin and other substances was achieved using Fast Performance Liquid Chromatography (FPLC).

RESULTS: The resulting immunotoxin was delivered to choroid plexus cells in culture and the results were compared to a non-specific immunotoxin. Complete cell death of choroid plexus cells with only one hour exposure to the specific immunotoxin as opposed to minimal cell death with a non-specific immunotoxin after several hours of exposure. Dosage studies are now complete and we are due to progress to an in vivo model using an intraventricular injection of the specific immunotoxin into the hydrocephalic rat model.

CONCLUSIONS: We have developed an immunotoxin that specifically destroys choroid plexus tissue in vitro.

66. Lumboperitoneal Shunts in Children

Authors: Harold L. Rekate, MD (Phoenix, AZ); Donna C. Wallace, RNNP (Phoenix, AZ)

INTRODUCTION: Recent literature has suggested that lumboperitoneal shunts carry excessive risks in children. We have found this form of shunting to have advantages over ventricular shunting therefore we wished to study the safety and efficacy of this procedure in the children we have treated.

METHODS: This is a retrospective study of patients treated for a variety of abnormalities of cerebrospinal fluid dynamics who were 18 years of age or younger at the time of the treatment. All patients were treated by the senior author and had at least a six month follow-up MRI scan and clinical information as well as a preoperative scan.

RESULTS: Twenty-five patients were identified. Indications for Lumbar shunting included postoperative pseudomeningocele (2 Patients), Pseudotumor Cerebri (11 patients), and severe slit ventricle syndrome requiring access to the subarachnoid spaces in 11 patients. Three patients had known hindbrain herniation requiring decompressive surgery before the placement of the shunt. No patient (0 of 25) became symptomatic as a result of the LP shunt. No patient developed new hindbrain herniation during the period of follow-up. Valve mechanisms were used in 21 of 25 of the children.

CONCLUSIONS: Lumboperitoneal shunts are safe and effective in carefully selected children.

67. Lumboperitoneal Shunting as a Treatment of Slit Ventricle Syndrome

Authors: Hoang N. Le, MD (Chicago, IL); David Frim, MD, PhD (Chicago, IL)

INTRODUCTION: Slit ventricle syndrome has been described in patients who continue to have shunt malfunction-like symptoms in the presence of a functional shunt system and small ventricles on imaging studies. These symptoms usually present years after initial shunt placement or revision and can consist of headache, nausea & vomiting, lethargy, and decreased cognitive skills. Treatments offered can range from observation, medical therapy (migraine treatment), shunt revision, to subtemporal decompression or cranial vault expansion. We describe a subset of patients with slit ventricle syndrome who were symptomatic with high intracranial pressure as measured by sedated lumbar puncture and whose symptoms completely resolved after lumboperitoneal (LP) shunt placement.

METHODS: Six patients with a diagnosis of slit ventricle syndrome underwent lumboperitoneal shunt. Age at shunting ranged from 7 to 18 year All had undergone recent ventriculoperitoneal (VP) shunt revisions for presentation of shunt malfunction-like symptoms. Despite this, all remained symptomatic and necessitated a sedated LP for opening pressure. All had high opening pressure in spite of a functional VP shunt and underwent LP shunt placement.

RESULTS: All six patients had a prolonged period of overdrainage symptoms that resolved. Complete resolution of their symptoms after LP shunting. Initial etiology of hydrocephalus was reported to include trauma, aqueductal stenosis, and hemorrhage of prematurity. Only one patient required revision of her LP shunt after which her symptoms again resolved.

CONCLUSIONS: In a certain subset of patients with slit ventricle syndrome who are symptomatic from increased intracranial pressure, placement of a lumboperitoneal shunt is an effective treatment option after VP shunt revision has failed. It appears that this subgroup of patients previously treated with VP shunting may behave most like patients with pseudotumor cerebri and respond well to LP shunting.

68. Stretching and Breaking Characteristics of Cerebrospinal Fluid Shunt Tubing

Authors: Daniel J. Tomes, MD (Omaha, NE); Leslie C. Hellbusch, MD (Omaha, NE); L. Russell Alberts, PhD (Omaha, NE)

INTRODUCTION: Cerebrospinal fluid (CSF) shunt system malfunction due to silastic tubing fracture necessitates revision surgery in shunt-dependent individuals. The goal of our study was to examine the mechanical stretching and breaking characteristics of new and used CSF shunt tubing catheters to determine if any inherent physical properties predispose the tubing to fracture.

METHODS: 50-millimeter (mm) segments of new and retrieved (used) CSF shunt tubing were stretched to 120-mm in a MTS Bionix 858 hydraulic press to determine modulus values (modulus = stress/strain) and to measure permanent tubing deformation imparted by the applied stress and strain. Similar 50-mm tubing segments were also stretched in an Instron Model 1000 electro-mechanical material testing system until fracture occurred with the force and strain needed to break the tubing being recorded at the time of failure.

RESULTS: Our results demonstrate shunt tubing of greater cross-sectional area requires greater force to fracture, and that catheters do become weaker the longer they are implanted. Barium impregnated shunt tubing, compared to translucent tubing, appears to require less applied stress and strain to break and may fracture more easily in vivo. The variety of modulus values obtained for the tested new catheters suggests the respective companies may be using materials of different quality in tubing manufacture.

CONCLUSIONS: CSF shunt catheter design incorporating tubing of greater cross-sectional area may lead to fewer indwelling catheter fractures and a reduction in shunt revision surgery.

69. An Estimate of the Natural Rate of Shunt Infections

Authors: Jeffrey W. Campbell, MD (Charleston, SC); Stephen J. Haines, MD (Charleston, SC)

INTRODUCTION: Shunt infection rates of 0 to 39% are reported in the literature, primarily from retrospective analyses of a single institution's experience. In order to more accurately estimate the average rate of shunt infection that might be expected from standard techniques and precautions, an extensive review the literature was performed to identify patients who were followed prospectively in a rigorous manner following a shunt operation.

METHODS: Most of these patients were enrolled in clinical trials or prospective cohort studies. Series were excluded if patients were followed for less than six months or if less than 85% of patients received peri-operative antibiotics. For clinical trials investigating the use of antibiotics, only patients who received antibiotics were included. Thirteen studies met these criteria, involving 1618 patients.

RESULTS: 137 infections were found for a rate of 8.45% (95%CI:7.16,9.93) with no significant difference (8.31%; 95%CI:6.66,10.21) in series restricted to pediatric populations (n = 987). A meta-analysis of studies reporting infection rates for shunt insertions separately from revisions revealed no significant difference (RR = 0.95; 95%CI:0.75,1.14). On the other hand, a meta-analysis of studies reporting infection rates separately for patients under and over one year of age revealed a significantly increased risk of infection in the younger patients (RR = 1.45; 95%CI:1.04,3.94) with an average infection rate of 14.45%.

CONCLUSIONS: Compared to the 1-2% infection rate seen with implantation of other devices, the rate of shunt infection using standard techniques seems unacceptably high. Most of the patients reported here were treated at tertiary care centers with a high number of annual shunt operations, suggesting that this 8% infection rate reflects the reality of current treatment in the best of hands. Retrospective series, particularly those describing a change in technique after an increase in an institutional infection rate, are highly susceptible to bias. Interventions that might lower the "natural" rate of shunt infections should be studied in the same rigorous manner applied to peri-operative antibiotics so they can be quickly integrated into the standard protocol of every institution.

70. Length of Antibiotic Therapy for the Treatment of Shunt Infection

Authors: Adam S. Arthur, MD (Salt Lake City, UT); John R.W. Kestle, MD (Salt Lake City, UT)

INTRODUCTION: The ideal duration of antibiotic treatment for shunt infection is not known. No study has objectively determined the best length of treatment, i.e. that which minimizes both hospital length of stay and the chance of reinfection. It might be assumed that as duration of therapy is shortened, the chance of reinfection rises. This study was undertaken to determine whether a rise in reinfection rate would be tolerated if the duration of therapy were shortened. This survey was sent to a sample of both the physicians who treat shunt infection and the patients who experience them.

METHODS: 61 ASPN members (44 responding) and 831 patients or parents of patients with shunts (385 responding) were surveyed using similar questionnaires. This questionnaire was designed to ascertain what rise in reinfection rate (0%, 1%, 2% or 4% difference) would be tolerated in order to treat for a shorter duration (3 days of sterile cultures versus 7–10 days).

RESULTS: 64% (28/44) of neurosurgeons and 47% (173/366) of patients responding to the survey would tolerate an increased reinfection rate in order to gain a shorter duration of treatment. These results document the minimal clinically important outcome of the treatment of shunt infection.

CONCLUSIONS: The results of this survey supports the feasibility of a planned study to evaluate the reinfection rates of varying lengths of antibiotic therapy for the treatment of shunt infection. A substantial number of both physicians and patients would opt for shorter duration of therapy and accept the possibility of an increase in reinfection rate. The viewpoints of both neurosurgeons and patients and their families are critically important to the design of any meaningful study aimed at optimizing the treatment of shunt infection.

71. Late Shunt Infection: Incidence, Pathogenesis, and Therapeutic Implications

Authors: Matthieu Vinchon, MD (Lille, France); Lemaitre Marie-Pierre, MD (Lille, France); Vallé Louis, PhD (Lille, France); Dhellemmes Patrick, MD (Lille, France)

INTRODUCTION: Although the vast majority of shunt infections occur within the two months following surgery, late shunt infections (LSI) occur in a number of cases. The incidence of infection unrelated to surgery is not established, and the sources of the germs are poorly understood.

METHODS: We reviewed 1793 pediatric cases treated in our department for hydrocephalus, with a mean follow-up of 9.12 years. We defined LSI as infection occurring more than one year after the last shunt operation.

RESULTS: We found 40 cases of LSI, representing 12.7% of all cases of shunt infection. The annual incidence of LSI was 0.28% of the shunted population. Peritonitis, generally due to appendicitis, was the cause of LSI in 11 cases. Hematogenous contamination was suspected in eight cases, because the germ was Haemophilus, Pneumococcus, or Listeria or an ENT infection preceded SI; the incidence of purulent meningitis was significantly higher than in the general population. LSI was due in seven cases to bowel perforation, and in four to direct inoculation, after abdominal surgery or traumatic exposure of the shunt. In the remaining 10 cases, no potential cause of infection was identified, and presence of a germ since the previous shunt operation was suspected.

CONCLUSIONS: SI represents a life-long threat after shunting, and may be unrelated to shunt surgery.

72. Sudden Death in Hydrocephalic Children Treated with Endoscopic Third Ventriculostomy

Authors: Conor Mallucci, MBBS FRCS (Liverpool, England); Paul L. May, MBBS FRCS FRCPCH (Liverpool, England); Mosin Javadpour, MBBS FRCS (Liverpool, England); Andrew AC Webb, FRCS FDSRCS (Liverpool, England)

INTRODUCTION: Sudden death following cerebrospinal fluid shunt failure has been documented in the neurosurgical literature. However, to our knowledge, this complication has not previously been reported in hydrocephalic patients who have been treated with endoscopic third ventriculostomy (ETV).

METHODS: We report two cases in which sudden death occurred following initially sucessful ETV. A 3-year old boy with post haemorrhagic hydrocephalus and an 11-year old boy with congenital aqueduct stenosis underwent successfull ETV with no postoperative complications.

RESULTS: Three months after surgery both patients were assymptomatic, and magnetic resonance (MR) imaging confirmed patent third ventriculostomies. However, both patients were found unresponsive in bed 4 months after surgery. One patient died at home, while the other was brought to hospital where insertion of an external ventricular drain revealed high CSF pressure. Despite CSF drainage the second patient also died. Post-mortem examinations were performed in both cases, and the findings will be discussed.

CONCLUSIONS: In conclusion, hydrocephalus remains a condition for life which is potentially fatal, and false reassurances about 'cure' following third ventriculostomy seem inappropriate. Guidelines for patients, families, and primary health care providers should emphasise this risk.

73. Repeat Third Ventriculostomy in Pediatric Patients

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

INTRODUCTION: The treatment of hydrocephalus in the pediatric population with a third ventriculostomy can provide long term shunt independence. Although the success rate of third ventriculostomy has been relatively well studied, the efficacy of repeat third ventriculostomy is unclear.

METHODS: We performed a retrospective review of patients below 18 years of age who underwent a third ventriculostomy over a 12 year period. A total of 50 third ventriculostomies were performed in 46 patients. Four patients underwent a repeat third ventriculostomy after the initial procedure failed.

RESULTS: Overall, the causes of hydrocephalus included pineal tumor in 8 patients (17%), aqueductal stenosis in 13 (28%), tectal tumor in 7 (15%), midbrain or pontine tumor in 7 (15%), and other causes in 16 patients (35%). Forty four cases had radiographic follow-up with a mean of 24.5 months (range, 1–117 months). Forty four percent of the third ventriculostomies required another cerebrospinal fluid diversion procedure to treat the hydrocephalus. Nine of the eleven patients (82%) with a history of meningitis had a failed third ventriculostomy. All four patients who had a ventricular shunt placed prior to age 1 year did not improve following the third ventriculostomy. Four patients underwent a repeat third ventriculostomy; three (75%) did not show clinical or radiographic improvement after the second procedure. Arachnoid scarring at the site of the previous third ventriculostomy was evident during surgery. There were no complications from the procedures.

CONCLUSIONS: Although a repeat third ventriculostomy may allow for shunt independence, it has a lower success rate and should only be used in selected cases. The reason for its failure may be due to a predisposition toward exuberant arachnoid scarring at the ventriculostomy site.

74. Endoscopic Third Ventriculostomy in Patients After Cerebrospinal Fluid Infection and or Hemorrhage

Authors: Shlomi Constantini, MD (Tel Aviv, Israel); V. Siomin, (Tel Aviv, Israel); G. Cinalli; A. Grotenhuis; A. Golash; S. Oi; K. Kothbauer; H. Weiner; J. Roth; A. Pierre-Kahn

INTRODUCTION: This study was performed to elucidate safety, efficacy, and indications for the endoscopic third ventriculostomy (ETV) in patients which had had intraventricular/subarachnoid hemorrhage and/or CSF infection prior to endoscopic surgery.

METHODS: The charts of 101 patients from 7 medical centers from around the globe included into the study were retrospectively reviewed. The age of patients ranged from 2 weeks to 68 years (mean = 11.9 ± 16.59). There were 62 male and 39 female patients. The mean follow-up period in all patients was 1.3 ± 1.51 year, while in successful patients it ranged from 0.6 to 10 years (mean = 6.4 months). 46 patients (45.5%) had a history of hemorrhage in the CSF, 42 patients (41.6%) had CSF infection, and 13 patients (12.9%) had both prior to ETV.

RESULTS: The success rate of the endoscopic operation in the hemorrhage group was 60.9%, and 64.3% in the infection group. In patients after both infection and hemorrhage only 23.1% of procedures were successful. There was no mortality in the present series. Complications were observed in 15 patients (14.7%): postoperative fever (n = 8), moderate bleeding during the procedure (n = 7), subdural hematoma necessitating surgical removal (n = 1), transient ataxia (n = 4), and contralateral hemiparesis in 3 patients. In patients with history of infection neither location, nor severity or number of infections influenced the outcome.The severity of hemorrhage did not alter success rate in post-hemorrhagic group. Interval between the onset of hydrocephalus and ETV was 3.15i5.16 years in successes, and 6.34i8.31 years in failures (p = 0.029). 25 post-IVH ex-prematures shunted prior to ETV had a 100%rate. ETV was successful in 9 out of 10 patients with primary aqueductal stenosis. Two patients with Chiari malformation were successes. In two patients with a history of Dandy-Walker malformation ETV failed.

CONCLUSIONS: ETV is safe in patients having sustained either intracranial hemorrha infection. It has a success rate comparable to the success rate in general series of pati In should be considered a procedure of choice in patients from these groups who pre with obstructive hydrocephalus. Endoscopy may also be offered to patients having su tained both hemorrhage and infection, although expectations in this group should be lower. The benefits of hydrocephalus cure without placement of hardware in some p from this group may prompt surgeons to offer ETV in selected cases. History of infect hemorrhage does not alter success rate of ETV in patients with primary aqueductal st

75. Intra-operative MRI and Pediatric Neurosurgery

Authors: Thomas M. Moriarty, MD, PhD (Louisville, KY); Todd Vitaz, MD (Louisville, KY); Joseph Christiano, MD (Louisville, KY); Paul Larson, MD (Louisville, KY); Norman Mayer, MD (Louisville, KY); Stephen Hushek, MD (Louisville, KY)

INTRODUCTION: Intra-operative MRI (iMRI) has been reported as a useful tool for t surgery. The volumetric imaging function, as well as the integrated real-time navigati capabilities should make iMRI a powerful adjunct to the management of pediatric ne surgical disease.

METHODS: The GE Signa SP 0.5 T vertically oriented magnet is used for imaging. It housed in a fully equipped neurosurgical O.R. Cases considered for iMRI presented t pediatric neurosurgery service; only cases where a significant advantage to the patier anticipated were taken to iMRI. Both the volume imaging (1–2 minutes) or near real- imaging (1–2 sec) functions were used for navigation, resection control, catheter plac and intra-operative updates.

RESULTS: 54 surgical cases were performed; 20 diagnostic imaging procedures were formed. The surgical cases include: craniotomy for tumor (21), craniotomy for vascul lesion (4), stereotactic biopsy (10), stereotactic VP shunt revision (7), stereotactic cyst agement (9), chiari decompression (1), spine biopsy (1), spine tumor resection (1). 1 ventional diagnostic images were done, 4 upright spine images were done. There we neurological, infectious or hemorrhagic complications.

CONCLUSIONS: The relative benefit of iMRI on a case by case analysis suggests that th availability of iMRI is a significant benefit to a general pediatric neurosurgical populatio

76. The Successful Utilization of a Mobile 1.5-Tesla Intra-operative Magnetic Resonance Imaging System During Pediatric Neurosurgical Procedures

Authors: Mark G. Hamilton, MDCM, FRCSC (Calgary,Alberta, Canada); Terry Myles, MD, FRCSC (Calgary, Canada); Taro Kaibara, MD (Calgary, Canada); Garnette Sutherland, MD, FRCSC (Calgary, Canada)

INTRODUCTION: We have previously reported the development of a high field (1.5 magnetic resonance imaging (MRI) system for use in the neurosurgical operating roo where standard neurosurgical tools (microscope, endoscopes, ultrasonic aspirator, bi coagulation, etc.) can be utilized. The magnet is moved to and from the neurosurgic utilizing overhead crane technology. High-definition T1- and/or T2-weighted images angiography can be acquired at various stages of the surgical procedure. A VectorVi BrainLAB Image-guided system is integrated into the MRI system. Patients can be re- tered after acquiring new intra-operative MR images.

METHODS: A prospective database has been maintained. Demographic and surgica was obtained from this source.

RESULTS: Twenty-five pediatric patients underwent surgery utilizing this intraoperati system over a 30 month interval. The average age was 11.6 years (range 16 months- years) with 14 male and 11 female patients. Patient diagnosis included tumor (n = 17 epilepsy (n = 4), AVM (n = 1), cavernous malformation (n = 2), and spinal cord tumor Immediate preoperative and intraoperative MR imaging was completed in all patient BrainLAB Image-guided system was utilized in 12 patients. Intraoperative imaging re in further tumor resection in 12 patients.

CONCLUSIONS: The use of a high-field intra-operative MRI system provides a significant advantage for the pediatric neurosurgeon during complex intra-cranial or spinal surgery. Immediate feedback concerning the extent of tumor resection, and the availability of an integrated frameless stereotaxy system that can be used with both preoperative and intra-operative images can greatly enhance surgical effectiveness and safety. Greater clinical experience will be required to validate this initial impression.

77. Utility and Safety of Intraoperative Magnetic Resonance Imaging for Pediatric Patients

Authors: Mark R. Proctor, MD (Boston, MA); Elizabeth A. Eldredge, MD (Boston, MA); Ferenc A. Jolesz, MD (Boston, MA); Liliana Goumnerova, MD (Boston, MA); R. Michael Scott, MD (Boston, MA); Peter M. Black, MD, PhD (Boston, MA)

INTRODUCTION: Magnetic resonance therapy (MRT) is a new technology in which the patient is operated on within a specialized MR scanner while concurrent imaging is performed. Unlike some units, no movement of the patient or equipment is required, and real time imaging can be obtained. We report on its safety and efficacy in the treatment of pediatric patients.

METHODS: The records and imaging studies of all pediatric patients treated in the MRT from June, 1997 to June, 2001 were reviewed to determine type of lesion, adequacy of resection, and associated treatment morbidity.

RESULTS: Thirty children ranging in age from 2–16 years (mean 7yrs) have undergone treatment for either brain tumor or cortical dysplasia in the MRT. The bulk of patients have had craniotomy for resection of the lesion, but other procedures include needle biopsy, transphenoidal resection, and thermal laser ablation of the lesion. Overall, the majority of the patients underwent a reoperative procedure in the MRT after failure of a previous surgical intervention using either standard surgical techniques or frameless stereotactic guidance; however, in the latter part of the series a higher percentage of patients have undergone a primary resection in the MRT. Cerebral hemisphere and cerebellum are the two most common lesion locations, with other lesions located in the brain stem and pituitary. The majority of cases are low-grade glioma, but also include GBM, PNET, hamartoma, adenoma and metastasis. Total resection by MR criteria was achieved in approximately 80% of cases. Mean surgical time was five hours. There were no complications or operative morbidity secondary to the MRT. Two patients have returned to the OR for radiographic recurrence, ten and six months after surgery.

CONCLUSIONS: MRT is a safe technology for use in pediatric patients. It has permitted localization and complete resection of tumors which could not be excised, or were considered unresectable, by standard techniques.

78. fMRI Demonstrates Residual Eloquent Cortex in Perinatal Stroke: Significance and Implications for Post-Surgical Functional Recovery

Authors: Samuel R. Browd, MD, PhD (Salt Lake City, UT); Marion L. Walker, MD (Salt Lake City, UT); Leeza Maron, PhD (San Diego, CA); Robin Gilmore, MD (Gainesville, FL); Steve Roper, MD (Gainesville, FL); Christiana Leonard, PhD (Gainesville, FL); Richard Briggs, PhD (Gainesville, FL); Bruce Crosson, PhD (Gainesville, FL); Douglas Brockmeyer, MD (Salt Lake City, UT); John Kestle, MD (Salt Lake City, UT)

INTRODUCTION: Functional MRI was performed on two patients with congenital hemiparesis secondary to perinatal stroke to localize motor function during pre-surgical evaluation.

METHODS: fMRI was performed at 1.5T using standard motor and sensory paradigms.

RESULTS: fMRI motor activation was seen in atypical locations within the damaged hemisphere (DH) in both patients suggesting local reorganization had occurred. Wada testing contradicted the ipsilateral reorganization seen with fMRI in the first patient as injection of the DH caused no hemiparesis; however, a second patient with extensive hemispheric damage became hemiparetic and aphasic after Wada injection of the damaged left hemisphere. fMRI was repeated post surgically in the first subject. Activation in the intact hemisphere (IH) was increased compared to presurgical activation. Specifically, mirror movements were topographically mapped onto two separate non-contiguous areas in the IH; findings not present pre-surgically.

CONCLUSIONS: Inhibition originating from the DH may affect corticospinal neurons (CSN) in the IH. Following resection, CSNs that project from the IH ipsilaterally to the paretic limb may be released from inhibition and provide the basis for improved motor control. It is likely that the location and extent of functional reorganization may be dependent upon the age at which the insult occurred. Importantly, functional hemispherectomy may provide seizure freedom without functional deficits even in patients with demonstrated fMRI cortical activation in the DH. The activation seen in the damaged hemisphere in the first subject may represent inhibitory activation that suppresses the fully reorganized ipsilateral motor cortex. Functional MRI is unable to distinguish excitatory from inhibitory neuronal activation. Therefore, fMRI activation in the DH must be viewed with caution and we suggest correlation with Wada testing is still necessary.

79. Distance of Motor Cortex from the Coronal Suture as a Function of Patient Age

Authors: Dennis J. Rivet, MD (Saint Louis, MO); Jeffrey G. Ojemann, MD (Saint Louis, MO); T.S. Park, MD (Saint Louis, MO)

INTRODUCTION: The anatomical relationship of motor cortex in relation to the coronal suture can be a valuable landmark. It is not known how skull and brain growth affects this relationship. Utilizing cortical mapping performed with subdural electrodes, we characterize how this relationship varies with age.

METHODS: We retrospectively identified the charts of 18 children who had undergone implantation of subdural grids for long-term video EEG monitoring during an evaluation for seizure surgery, and who had cortical mapping performed to localize sensorimotor cortex. 18 patients (11 females, 7 males) were identified from the period 1995 to 2000. Age range was 1 to 14 years (mean 8.7 years). In 16 patients the motor cortex was localized; 7 patients the central sulcus was localized with somatosensory evoked potentials. Data for both were available for 5 patients. On post-implantation lateral skull x-rays, the coronal suture was identified at its medial aspect (where it is readily visible) and the distance measured to the electrodes overlying motor cortex and/or central sulcus.

RESULTS: The mean distances from the coronal suture to the motor cortex and central sulcus were 32.8 mm +/- 6 mm (range 22.7-43.3mm) and 50.3 mm +/- 4.7, (range 40.9-55.4mm) respectively. The location of the motor cortex correlated significantly with age (correlation coefficient, $r = 0.78$; $p < 0.01$) and increased at the rate of 1.2 mm/year.

CONCLUSIONS: The distance of Rolandic cortex from the coronal suture increases with patient age. This variability has implications for determining location of eloquent structures based on anatomic landmarks.

80. Approaches to the Third Ventricle: a Pediatric Surgical Series of 25 Patients

Authors: Charles Teo, MD (Sydney, Australia); Peter Nakaji, MD (San Diego, CA)

INTRODUCTION: Historically, approaches to the third ventricle have been associated with unacceptably high complication rates. Indeed, many pediatric neurosurgeons still advocate biopsy of tumors in this most sensitive area rather than attempt radical tumor removal. The object of this study was to determine the safety of current approaches to the third ventricle and outcomes of these patients, given the utilization of recent technological advances such as endoscopy.

METHODS: The study included 25 patients, less than 18 years of age, who underwent surgery for third ventricular tumors and who had been followed for more than 6 months. The operative approach, immediate and long term outcomes, degree of tumor resection, histological diagnosis, and complications were noted.

RESULTS: The approaches employed were the retro-callosal/transtentorial, transcallosal/sub-forniceal and the transcallosal/trans-foraminal techniques with and without endoscopy. Complete macroscopic removal was achieved in 22 patients (89%). Despite the many posteriorly located third ventricular tumours, only one was a pure germinoma. One patient had worsening of her neurological status after surgery, one died in the second post-operative week from status epilepticus and the remaining patients did extremely well. Those patients with low grade tumors are alive and well at a mean follow-up of 31 months.

CONCLUSIONS: It appears the results from total resection of third ventricular tumors has improved compared to historical controls. The authors would like to underscore the importance of endoscopy in the surgical approach to this area, the low risk associated with the occipital (retrocallosal)/ transtentorial approach to the third ventricle and the disparity in histological tumor types with complete resection compared to those series of patients having stereotactic needle biopsy only.

81. Medial Pectoral Nerve Transfer for Reinnervation of the Biceps and Deltoid

Authors: Paul A. Grabb, MD (Birmingham, AL); Charlie Law, MD (Birmingham, AL)

INTRODUCTION: When an upper brachial plexus injury is so proximal as to prevent cable grafts, nerve transfers can be employed to achieve reinnervation. We describe a series of children treated with medial pectoral nerve (MPN) transfers to the musculocutaneous (MCN) and axillary nerves.

METHODS: Eight children underwent MPN transfers over a four-year period. Six infants sustained birth injuries and were operated on from five to 11 months of age. Two children, ages 17 months and seven years, sustained injuries in motor vehicle accidents and were operated on eight months after injury. MPN transfers were chosen for reinnervation when evidence from clinical examination, microsurgical inspection, and intraoperative electrophysiological studies supported no viable output from the C5 or C6 roots, but viable medial cord function. Assessments of motor function were obtained at 3 month intervals postoperatively. Hand function at surgery, time to nerve transfer, age, follow-up, and time to recovery were recorded.

RESULTS: Six children had MPN to MCN transfers, one child had an MPN to axillary nerve transfer, and one child had an MPN to MCN transfer along with a sural cable graft from C6 to the MCN. Follow-up was three to 55 months. Six children had functional hands, one child had poor hand function, and one had no hand function at surgery. Six children have regained at least antigravity strength in the target muscle from five to nine months postoperatively. The two children without reinnervation have follow-ups of three months and 25 months. This latter child was the only to have no hand function at surgery.

CONCLUSIONS: Reinnervation of the target muscles with at least antigravity strength was obtained with medial pectoral nerve transfer in all children within nine months of surgery who had hand function at surgery. In children with no hand function at the time of brachial plexus reconstruction, medial pectoral nerve transfer should not be employed regardless of intraoperative electrophysiological findings.

82. Entrapment Neuropathy contributing to Dysfunction after Birth Brachial Plexus Injuries

Authors: P. David Adelson, MD (Pittsburgh, PA); N. Ake Nystrom, MD (Pittsburgh, PA); Robert Sclabassi, MD (Pittsburgh, PA)

INTRODUCTION: Brachial plexus (BP) injuries following birth trauma remain a leading cause of peripheral nerve dysfunction in children. While surgical intervention has been successful in improving function, these children often continue to suffer functional limitations, particularly with axillary nerve (AN) and posterior cord (PC) function.

METHODS: To investigate the etiology of the ongoing dysfunction after BP injury, older children (> 5 y) with a static brachial plexopathy following birth trauma were taken to the operating room for inferior BP exploration and neurolysis. Intraoperative EMG of the BP was obtained using threshold values prior to neurolysis in adducted and then fully abducted positions. EMG were repeated following extensive neurolysis of the AN and PC and decompression of the AN at the quadrangular space.

RESULTS: Baseline threshold EMG of AN and PC distributions were elevated (1.5- 2.5V) and would markedly increase (> 50%) with elevation/ abduction of the arm. Following extensive neurolysis and decompression of the inferior BP, particularly AN and PC, threshold values markedly decreased, (<.75V), and did not change with position indicating improved conductivity.

CONCLUSIONS: These preliminary results would seem to indicate that part of the static plexopathy in children after birth trauma may be due to scarring and entrapment of the AN at the quadrangular space. Earlier exploration and neurolysis of the inferior BP may be considered since the primary procedure alone for BP injuries may be inadequate for the range of pathology in these children.

83. Pediatric Neurosurgery Fellowship after Forty

Authors: Howard J. Silberstein, MD, FACS (Rochester, NY)

INTRODUCTION: After nine years of working in an adult neurosurgery private practice, the author took a fellowship position in pediatric neurosurgery in order to fill a need for a pediatric neurosurgeon in his community. Since his residency, the American Board of Pediatric Neurosurgery has implemented a separate board certification process. In order to be eligible for certification, the author needed to complete an accredited one year pediatric neurosurgery fellowship. This talk will discuss the motivation, experiences and perspective of an established neurosurgeon who becomes a fellow in pediatric neurosurgery after the age of forty.

METHODS: See Above

RESULTS: See Above

CONCLUSIONS: The implemented board certification process by the American Board of Pediatric Neurosurgery is recognized and now required at many university and community medical centers. Pediatric neurosurgery board certification has raised the expected community standard for providing neurosurgical care to the pediatric population. Despite the unconventional pathway to pediatric neurosurgery fellowship, the author reports on the great educational value of being a pediatric neurosurgery fellow. Having nine years of neurosurgical practice experience and being a parent for the past ten years, gave the author an added perspective during his pediatric neurosurgery fellowship. The pediatric neurosurgery fellowship experience after the age of forty provided the author with a great template for understanding and practicing pediatric neurological surgery.

84. Endoscopic Approach to Pineal Region Tumors

Authors: Bakhtiar Yamini, MD (Chicago, IL); Charles Rubin, MD (Chicago, IL); David M. Frim, MD, PhD (Chicago, IL)

INTRODUCTION: Patients with pineal region masses often have associated hydrocephalus. Optimal initial treatment in neurologically stable patients remains controversial. Generally, management requires both a diagnostic approach for biopsy as well as a therapeutic component in addressing hydrocephalus. These two goals potentially can be achieved in a single minimally invasive procedure by use of the neuro-endoscopy.

METHODS: 8 consecutive patients, between the ages of one to 20 years old, in stable neurologic condition with hydrocephalus and pineal region masses initially were managed endoscopically.

RESULTS: 5/8 (63%) endoscopic procedures were successful in that the diagnosis was made with the initial procedure and hydrocephalus was initially treated by cisternostomy. In one patient the diagnosis made on endoscopic biopsy was different from the subsequent diagnosis obtained on open craniotomy. In one patient the biopsy was non-diagnostic and in one patient the biopsy was aborted due to inability to visualize the tumor. In all cases a 3rd ventriculocisternostomy was performed without complication however, subsequent ventriculoperitoneal shunting was necessary in 5/8 (63%) patients. There was one patient who hemorrhaged into her tumor several hours after the endoscopic biopsy at a site distant from the biopsy site.

CONCLUSIONS: The endoscopic approach for initial management of stable patients with pineal region masses is a viable option. However, one must be aware that often these patients may eventually require shunting. In addition, diagnostic efficacy of the biopsy is limited by the approach and the small sample size.

85. Craniovertebral Abnormalities in Type VI Mucopolysaccharidosis (Maroteaux-Lamy Syndrome)

Authors: Ian D. Kamaly-Asl, FRCS (Manchester, England); John A. Thorne, FRCS (SN); Mohsen Javadpour, FRCS; David G. Hughes, FRCR; Ed Wraith, FRCPCH; Richard A. Cowie, FRCS (SN)

INTRODUCTION: The Craniovertebral abnormalities found in patients with Type VI mucopolysaccharidosis (Maroteaux-Lamy syndrome) are described, and the indications for and outcomes of surgery in this group are assessed.

METHODS: The clinical histories and radiological findings in all patients with Type VI mucopolysaccharidosis treated at Royal Manchester Children's Hospital during the past 10 years were reviewed.

RESULTS: The typical findings in patients with this disease are of canal stenosis at the level of the foramen magnum and upper cervical spine with or without compression. The stenosis is secondary to thickening of the posterior longitudinal ligament. Atlantotaxil instability is rare. Of nine patients under regular clinical review, four underwent decompressive surgery for cervical cord compression. Three of the four showed improvement in their neurological symptoms and signs postoperatively. Of the children reviewed, six had had radiological evidence of cord compression, although only those with neurological signs or symptoms were treated surgically.

CONCLUSIONS: Despite the often formidable anesthetic challenge, surgery is indicated in those patients who present with progressive neurological deficit due to cervical myelopathy. Surgery can be undertaken safely if the associated medical problems in these children are recognized and managed appropriately.

86. Temporal Evolution of Brain Injury in Term Newborns Characterized by Diffusion Tensor Imaging

Authors: Robert C. McKinstry, MD, PhD (St. Louis, MO); Jeffrey H. Miller, MD (St. Louis, MO); Amit Mathur, MD (St. Louis, MO); Abraham Z. Snyder, MD, PhD (St. Louis, MO); T. S. Park, MD (St. Louis, MO); Jeffrey J. Neil, MD, PhD (St. Louis, MO)

INTRODUCTION: Diffusion tensor imaging is a new MRI method which demonstrates a variety of forms of brain injury within minutes of onset. We assessed the temporal evolution of changes in water apparent diffusion following injury in human newborns.

METHODS: We prospectively evaluated 12 newborns who were the products of normal pregnancies, suffered an injury at birth, and had evidence of that injury after birth (e.g., decreased level of alertness, seizures, reduced urine output). The injuries resulted from well-defined causes including "tight nuchal cords" at delivery; direct trauma related to difficult forceps delivery and uterine rupture. Infants underwent diffusion tensor imaging and conventional MRI studies during the first 24 hours of life, on day of life (DOL) #3, and on DOL#7.

RESULTS: In regions of brain injury, values for the water apparent diffusion coefficient were reduced maximally on DOL#1 and DOL #3. They were still reduced, but less so, on DOL #7. The regions of injury evident on the diffusion tensor images were not conspicuous on standard T1- and T2-weighted MRI scans until at least DOL #3.

CONCLUSIONS: These preliminary data indicate that diffusion tensor imaging shows brain injury earlier than conventional MRI in newborns and may provide a means for estimating of the age of the injury in the postnatal period.

87. Hyperglycemia is a Poor Prognostic Sign in Pediatric Head Injury

Authors: Francesco Sala, MD (Verona, Italy); Massimo Miscusi, MD (Verona, Italy); Marianna Manfrini, MD (Verona, Italy); Carlo Mazza, MD (Verona, Italy); Luciano Cristofori, MD (Verona, Italy); Albino Bricolo, MD (Verona, Italy)

INTRODUCTION: While a detrimental role of hyperglycemia after traumatic brain injury has been extensively reported for adults, whether or not hyperglycemia retains a poor prognostic value in pediatric head injury remains debated.

METHODS: We retrospectively reviewed charts of all children admitted to our hospital since 1991 with moderate (GCS 9-13) and severe (GCS <8) head injury, in order to assess: 1) the incidence of hyperglycemia [blood glucose values (BGs) >7 mmol/l] up to 72 hours after injury; 2) correlations between BGs up to 72 hours after injury and: a) the admission GCS; b) the GOS at discharge.

RESULTS: Forty five patients were included; 7 presented with associated extracranial injuries. Admission hyperglycemia was recorded in 75.6% of 37 children admitted within 5 hours from injury. At 24 hours hyperglycemia was recorded in 57% (20/35) and at 72 hours in 13.6 % (3/22) of children whose records were available. Admission BGs were significantly higher in children with severe (mean 12.9mmol/l) versus moderate (mean 9.1mmol/l) head injury ($p=0.019$). Admission BGs were lower in children with GOS 4-5 (mean 9.3mmol/l) compared to those with GOS 2–3 (mean 14.3mmol/l), and significantly lower compared to those who died (mean 14.4 mmol/l) ($p=0.010$). BGs at 24 hours were significantly lower in children with GOS 2–5 (mean 8 mmol/l) compared to those who died (mean 26.1 mmol/l) ($p<0.005$). Admission GCS significantly correlated with GOS ($p<0.0001$).

CONCLUSIONS: In pediatric head injury:1) hyperglycemia is frequently observed in the first 24 hours after injury; 2-3) BGs correlate with injury severity and neurological outcome. A cause-effect relationship between elevated BGs and poor neurological outcome would involve hyperglycemia as co-factor in secondary mechanisms of brain injury and deserves further investigation.

88. Smarter Dummies: Infant Head Injury Mechanism Studies Using Improved Anthropomorphic Modeling

Authors: Ann-Christine Duhaime, MD (Philadelphia, PA); Michael T. Prange, PhD (Philadelphia, PA); Cindy Christian, MD (Philadelphia, PA); Susan S. Margulies, PhD (Philadelphia, PA)

INTRODUCTION: In the mid-1980's, a collaborative effort between neurosurgery and bioengineering at the University of Pennsylvania led to the use of anthropomorphic models to investigate shaking and impact injuries in human infants. These studies have been criticized because of limitations in the models themselves and because of questions about tissue injury thresholds during immaturity. Work done in the intervening years has attempted to fill in some of the gaps in information by using in vivo and in vitro tissue testing (brain, skull, sutures, and veins). Recently a new anthropomorphic model has been created which allows for direct measurement of both angular and translational velocities as well as contact loads experienced by the head.

METHODS: Falls from 1', 3', and 5' onto concrete, carpet pad, or foam were performed. The models were also shaken repeatedly and then impacted against a rigid surface. Rotational velocities and decelerations were compared to thresholds for inertial rotational injury in the 3–5 day old piglet.

RESULTS: Maximum change of angular velocity (Dwmax) and peak angular acceleration (amax) were greater with falls from higher heights and onto harder surfaces. Shakes had similar amax to falls onto a foam mattress and similar Dwmax to a 1' fall onto concrete and carpet pad. A 5' fall onto a hard surface produced an amax greater than that found to correlate with tissue tears and scattered axonal damage in non-impact rotation in piglets. Loads measured during inflicted impacts were significantly greater than all other conditions.

CONCLUSIONS: These studies, using more advanced modeling techniques, show that inflicted impact mechanisms produce conditions most likely to create serious brain injury. Modeling limitations and data relevant to the possible role of cervical spine injury will also be discussed.

89. Folic Acid Supplementation Improves CNS Regeneration and Outcome after Spinal Cord Injury in Rats

Authors: Bermans J. Iskandar, MD (Madison, WI); Daniel K. Resnick, MD (Madison, WI); Nithya Hariharan, MD (Madison, WI); Gao Peng, MD (Madison, WI); Nelson Aaron, (Madison, WI); Johnson Chenara, (Madison, WI); Cechvala F. Cate, (Madison, WI)

INTRODUCTION: Since folic acid was shown to play a significant role in preventing neural tube defects, we thought it reasonable to examine its role in CNS regeneration. We have thus studied the effect of 80 mcg/kg of folic acid on axonal elongation in vivo in 2 different rat models, and the animals' functional outcome after spinal cord injury.

METHODS: In the rat optic nerve model of CNS regeneration, the optic nerve is sectioned then grafted with a sciatic nerve segment. The end of the graft is backfilled with a fluorescent tracer 2 months later. The retina is then harvested and studied for the presence of fluorescence, indicating regenerating retinal ganglion cells (RGCs). In the spinal cord model, the cervical dorsal columns are injured and a sciatic nerve segment is grafted at the injury site. The dorsal root ganglia are harvested, sectioned, and studied for fluorescence. Folic acid was given intraperitoneally in a dose-escalating pattern. In vitro protocols were used to study axonal elongation in response to peripheral injury, spinal injury, and folic acid. Finally, a spinal cord weight-drop model of thoracic spinal cord injury was used to analyze locomotion outcome using a standardized point-score system (Basso, Beattie, and Bresnahan score).

RESULTS: In the optic nerve model, the mean number of axons elongating into the graft increased from 913+/-SD57 to 1373+/-SD208 per retina after folic acid treatment. In the spinal cord model, the amount of regeneration in vivo increased from 1.37%+/-0.25% to 16.70%+/-1.21% with maximum dose dependence. Folic acid also improved the BBB score at 6 weeks postinjury by 6 points ($p = 0.01$). Finally, in vitro analysis indicates that folic acid enhances axonal elongation in response to folic acid, but only when the drug is given in vivo in injured animals.

CONCLUSIONS: These results suggest that folic acid and the folate metabolism play a significant role in CNS regeneration. The impact of these findings on the treatment of head and spine trauma and other neurological disorders might be considerable and warrants investigation.

90. Clinical Significance of CervicoMedullary Deformity in Chiari II Malformation

Authors: Prithvi Narayan, MD (Atlanta, GA); Timothy B. Mapstone, MD (Atlanta, GA); Shane Tubbs, SA (Birmingham, AL); Paul A. Grabb, MD (Birmingham, AL); Timothy Frye, MD (Birmingham, AL)

INTRODUCTION: The purpose of this study was to determine if there is a difference in the caudal extent of brain stem herniation and degree of cervicomedullary deformity between symptomatic and asymptomatic Chiari II patients.

METHODS: The brain magnetic resonance imaging (MRI) studies and clinical presentation of 14 symptomatic and 59 asymptomatic patients were analyzed retrospectively. The level of the cervicomedullary deformity below the foramen magnum (FM) was measured in both groups. The level of the deformity was identified by the cervical vertebral body or disc space level.

RESULTS: There was considerable overlap between the two groups of patients based on the type of deformity and the vertebral levels of the deformity.

CONCLUSIONS: Review of our results shows no obvious relationship between the level of cervicomedullary deformity and the presenting symptoms or the outcome after surgical decompression. We conclude that the level of herniation and the cervicomedullary deformity is not a reliable marker to determine which patients may become symptomatic and require decompression or to determine prognosis.

91. Guidelines for the Management of Severe Head Injury in Children: Update

Authors: Nathan R. Selden, MD, PhD (Portland, OR); David Adelson, MD (Pittsburgh, PA); Susan Bratton, MD (Ann Arbor, MI); Nancy Carney, PhD (Portland, OR); Randall Chesnut, MD (Portland, OR); Hugo duCoudray, PhD (Portland, OR); Brahm Goldstein, MD (Portland, OR); Peter Kochanek, MD (Pittsburgh, PA); Helen Miller, MD (Portland, OR); Michael Partington, MD (St. Paul, MI)

INTRODUCTION: Guidelines for the management of severe head injury1 have been widely disseminated amongst neurotrauma practitioners. These guidelines have altered and systematized practice and contributed to uniformity amongst centers conducting clinical head injury research in adults. An ongoing project to formulate pediatric head injury guidelines will be reviewed.

METHODS: An interdisciplinary team of experts from pediatric neurological surgery (3), adult neurological surgery/neurotrauma (2), pediatric intensive care (2), pediatric emergency medicine (2) and evidence-based medicine (2) was formed under the auspices of the International Brain Injury Association. Oregon Health & Science University, one of 12 federally funded evidence-based practice centers, has served as host institution. Medical reference databases were searched for clinical scientific literature pertaining to treatments for pediatric head injury. Treatment effectiveness was evaluated and the strength of the evidence was classified using an established schema.

RESULTS: 18 topics (14 similar to those in the adult guidelines and 4 new) were subjected to literature review, screening by two panel members per topic and final review and classification by the entire group. These peer-reviewed publications constitute the evidence now being used to formulate practice standards, guidelines and options.

CONCLUSIONS: The clinical, scientific and social challenges posed by severe pediatric head injury merit further research that will identify appropriate treatment protocols in children and adolescents. The Pediatric head injury guidelines will serve as a foundation for further progress in clinical care and research. 1Reference: Journal of Neurotrauma (2000), Vol. 17, Number 6/7, 452-538.

92. Incidence of Delayed Intracranial Hemorrhage in Children with an Uncomplicated Minor Head Injury

Authors: Mark G. Hamilton, MDCM, FRCSC (Calgary, Alberta); Tanya Tran, BSc (Calgary, Alberta); Jennifer J. McGuire, BSc, MSc (Calgary, Alberta); Christine Malcolm, BSc (Calgary, Alberta); David W. Johnson, MD, FRCPC (Calgary, Alberta)

INTRODUCTION: The purpose of this study was to determine the incidence of delayed intracranial hemorrhage (DIH), and to approximate the proportion of children presenting to an emergency department (ED) with an uncomplicated minor head injury (UMHI) who are subsequently diagnosed with DIH.

METHODS: All children (0–14 years) residing within our regional health authority who were evaluated in one of our regional EDs and/or hospitals for HI between 1992/93 & 1999/2000 were identified through databases using discharge diagnoses (ICD9-CM). Cases of DIH (intracranial hemorrhage not apparent upon initial evaluation resulting in a LOC deterioration; diagnosed >6 hours after injury) were identified by reviewing the medical records of all suitable children and all Medical Examiner's reports of children who died outside a health care facility. All cases meeting any aspect of the DIH definition were independently reviewed by three neurosurgeons. Any cases for which there was not complete agreement among the reviewers were resolved by consensus. The number of cases of UMHI (HI without loss of consciousness/amnesia, a non-focal neurological exam and normal GCS score) was estimated by reviewing a randomly selected sample of charts (3,002) drawn from all ED visits (19,279) by children with a discharge diagnosis suggesting an UMHI. The base population at risk for DIH was obtained from census-based estimates.

RESULTS: Two cases met our definition of DIH. The estimated incidence of DIH in our study population was 1.1 cases per year/100,000. Of the 19,279 records with diagnosis of UMHI, 17,962 (95%CI 17,412 to 18,511) met our study definition. The proportion of children with UMHI who developed DIH was 2/17,962 or 1/8981 (95%CI 1/8707 to 1/9256).

CONCLUSIONS:The incidence of DIH in our study population was extremely low.

93. Single Photon Emission Computed Tomography in Mild to Moderate Head Injury: A Developing Modality

Authors: Larry Binkovitz, MD (Columbus, OH); Scott Elton, MD (Columbus, OH); Edward Kosnik, MD (Columbus, OH)

INTRODUCTION: The effects of closed head injury on the developing cerebral cortex are somewhat difficult to recognize. Understanding the nature of multiple concussions and the risk of permanent damage is vital in coming to a recommendation for these children as to further athletic participation. Early recognition of those most at risk for sustained post-concussive symptoms may allow therapy to be targeted to those most in need. In children with mild or moderate closed head injuries traditional imaging studies are frequently normal. Nuclear brain single photon emission computed tomography(SPECT), provides a mapping of regional cerebral blood flow non-invasively and has been shown to be more sensitive for abnormalities than CT and MRI. Limited retrospective studies have indicated that there is a correlation between persistent symptoms and brain SPECT abnormalities. We have studied several children with this modality following multiple "concussions." The nature of the study along with a review of these patients will be discussed.

METHODS: Serial nuclear SPECT imaging of children with mild to moderate (Glasgow coma score 9–15) concussions.

RESULTS: With serial SPECT, virtually all patients in this study group had improvement in their imaging.

CONCLUSIONS: SPECT imaging helps to advise children (especially athletes) as to activities after these "mild head injuries."

94. Management of Traumatic Occipito-Cervical Instability in the Very Young

Authors: Saadi Ghatan, MD (Seattle, WA); David W. Newell, MD (Seattle, WA); Jens R. Chapman, MD (Seattle, WA); Soheil K. Mirza, MD (Seattle, WA); Michael S. Grady, MD (Philadelphia, PA); Frederick A. Mann, MD (Seattle, WA); Richard G. Ellenbogen, MD (Seattle, WA)

INTRODUCTION: Young children are susceptible to higher cervical spine injuries, complete neurological deficits, and a concomitant rise in mortality after spinal cord injury (SCI). Children 3 years of age and younger represent a distinct subpopulation of pediatric patients at particular risk for high cervical and craniovertebral injury. Descriptions of atlanto-occipital dislocation (AOD) and atlanto-axial instability (AAI) survivors amongst the very young are limited, and there is a similar paucity of data regarding how best to manage these patients after initial emergency stabilization.

METHODS: We describe three children, ages 1 month to 32 months, who presented with high cervical and atlanto-occipital injuries. The etiology of their injury, neurological examination at presentation and follow-up (27–70 months), radiological diagnoses, and treatment course were reviewed.

RESULTS: One child (age 1 month) suffered AAI after violent shaking due to child abuse; the second (age 18 months) sustained both AAI and AOD after being struck by an automobile; the third child (age 32 months) suffered AOD by the same mechanism. The children had variable neurological findings at presentation, ranging from neck pain to Bell's cruciate paralysis, but all have recovered with minimal to no neurological deficit. All three children were successfully treated with immobilization in a custom orthosis (1 month old) or halo brace.

CONCLUSIONS: While rigid internal fixation followed by immobilization should be performed in adult and older pediatric survivors of AOD and AAI, surgical treatment of the largely cartilaginous spine in children less than 3 years of age is problematic. We believe that immobilization is a safe and effective alternative in the treatment of craniocervical and upper cervical instability in the very young.

95. Refuting Untenable Mechanisms of Fatal Head Injury and G Force Calculations in the Prosecution of Child Abuse Cases

Authors: William Micheal Vise, (Jackson, MS)

INTRODUCTION: An estimated 3.4 million child abuse cases occur annually in the United States. A third of these cases may involve severe head injury. The use of g force calculations in short distance falls is a commonly employed technique by defense attorneys to confuse juries and undermine physician testimony.

METHODS: Contrary to common knowledge the defense has usually calculated g force values three times higher than what can be generated in the alleged accident scenario which they present. Their math is correct, they have used the correct formulas, but they did not allow for skull deflection which makes the final value wrong, usually by a factor of three. Also the impunity of substantial g forces to the parenchyma of the brain when dissipated within a few milliseconds is not commonly appreciated.

RESULTS: A mathematical model was developed to establish a threshold value for initiation of diffuse axonal injury, based upon existing primate data. Simplification of the calculations for g forces is presented. Several useful analogies relating the dissipation of g forces to other commonly observed physical phenomena were developed for jury education.

CONCLUSIONS: A diffuse parenchymal injury on CT Scans is pathognomonic for experimentally induced ìdiffuse axonal injuryî and suggests a lateral axis of injury and much higher g forces than can be generated by short distance falls. Refutation of g force data in short distance falls can be accomplished with the inclusion of 0.5 inch skull defection in the calculations for children. Extraction of a very detailed history of the alleged accident from the suspected abuser at the time of hospital admission is important in limiting speculation by the defense at trial as to mechanisms of injury.

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NOTES ON ORAL ABSTRACTS

AANS/CNS SECTION ON PEDIATRIC NEUROLOGICAL SURGERY

30TH ANNUAL MEETING

November 28–December 1
New York, NY

POSTER INDEX

POSTER INDEX

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ck, MD (Minneapolis, MN)

MD (Orlando, FL), Eric R.
FL), Amy Dean, RN (Orlando, FL)

MD (Burlington, VT), Steven P.
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POSTER INDEX

ault Reconstruction in a Patient

Jackson, MS), Michael Angel,

d Fixation for Craniosynostosis

con, MS), Michael Angel, MD

y: Improvement in The

Jackson, MS), V.V.
kson, MS)

Shunt Revision

Washington, DC)

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MD, F.A.C.S. (Columbia, MO)

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mphis, TN),
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101. Combinatorial EphA Family Gene Expression Defines Embryonic Zones and Emerging Cortical Regions in the Neocortex and Prospective Nuclei in the Thalamus

Authors: Randall R. Johnson, MD, PhD (New Haven, CT), Mihae E. Yun, BS (New Haven, CT), Anica Antic, PhD (New Haven, CT), Maria J. Dongohue, PhD (New Haven, CT)

INTRODUCTION: The developmental program that parcellates mammalian cerebral cortex and thalamus into functionally distinct and uniquely connected areas and nuclei remains unclear. Here, we focus on potential roles for EphA family receptor tyrosine kinases and ephrin-A ligands in this process.

METHODS: We examined patterns of expression of individual members of this gene family in embryonic and early postnatal mouse brain by in situ hybridization using gene-specific probes. In addition, neuronal cell cultures and RT-PCR were used to probe the effect of removing both normal cellular contacts and thalamocortical input. Finally, the role of thalamocortical connectivity was specifically addressed using Mash-1 mutant mice in which the majority of thalamocortical connections fail to develop.

RESULTS: We show that unique combinations of EphA gene expression mark transient embryonic zones within the wild type cerebral wall. At more mature embryonic ages, distinct anteroposterior domains appear within the condensing cortical plate, marking presumptive visual, somatosensory, motor, association, and pre-frontal domains. Regional cell identity appears to be -pre-specified+ since postmitotic neurons that are not yet innervated by the thalamus show differential expression. Most patterns of EphA gene expression remain stable following both perturbation of normal cellular contacts when cells are grown in culture and elimination of normal thalamocortical input in Mash-1 mutant mice. Furthermore, patches of gene expression appear in dorsal thalamus both in wild type and Mash-1 mutant mice, which give rise to distinct nuclei including medial geniculate, lateral geniculate, ventroposterior, lateral posterior (pulvinar homologue), and mediodorsal nuclei. These thalamic compartments are often mutually exclusive, reminiscent of other parts of the nervous system with strict boundaries and well defined compartments.

CONCLUSIONS: These results suggest that EphA family members may play a role in establishing autonomous neuronal identity that gives rise to distinct cortical areas and thalamic nuclei, largely independent of thalamocortical connectivity.

102. Spinal Epidural Hemorrhages From Epidural AVMs in Young Children—A Radiological and Pathological Correlative Series

Authors: Patrick A. Lo, MD, BSc (Med), FRACS (Melbourne, Australia), Peter B. Dirks, MD, PhD, FRCSC (Toronto, Canada), James M. Drake, MB, BCh, MSc, FRCSC (Toronto, Canada), James T. Rutka, MD, PhD, FRCSC, FACS (Toronto, Canada), Laurence E. Becker, MD, FRCPC, FACP (Toronto, Canada)

INTRODUCTION: Spontaneous spinal epidural hemorrhages (SSEH) in children are rare. The most common site is the cervical spine (Patel et al, Ped Neurol 1998). The causes are often obscure with vascular malformations being one possible etiology (Wittebol et al, Clin Neurol Neurosurg 1984). However, confirmatory radiological and pathological findings are seldom present. Symptoms and signs related to SSEH may not be easily recognised in young children. The aim of this series is to present confirmatory radiological and pathological evidence of an epidural arteriovenous malformation (AVM) as the possible cause of SSEH in young children.

METHODS: We present three cases of thoracic SSEH in young children aged 16 months to 5 years, resulting from an epidural AVM. Each case presented with a vague history of back and leg discomfort, followed by an acute and rapid deterioration in neurological function. In all three cases, a large epidural thoracic hematoma was evident on MRI. Spinal angiography confirmed an epidural AVM in two cases. Two cases were managed with early surgery and one had an endovascular ablative procedure followed by surgery. Pathological examination confirmed the findings of an AVM in each case.

RESULTS: All three patients showed marked improvement in neurological function after surgery at one-year follow-up. No evidence of residual AVM was detected at follow-up angiography.

CONCLUSIONS: These cases support the notion of a vascular malformation as the cause of SSEH in children. The outcomes of these cases confirm the reported good results derived from early surgery (Pecha et al, Arch Phys Med Rehabil 1998). A spinal epidural AVM can be proven pathologically and radiologically as the cause of SSEH in young children, and should be considered in cases of nebulous back and leg symptoms with rapid neurological deterioration.

103. Management of Complex Pediatric Intracranial Arteriovenous Dural Fistulae

Authors: Sanjay N. Misra, MD (Dallas, TX), Duke Samson, MD (Dallas, TX), Thomas Kopitnik, MD (Dallas, TX), Lee Pride, MD (Dallas, TX), Philip Purdy, MD (Dallas, TX)

INTRODUCTION: Intracranial arteriovenous dural fistula with cortical venous drainage are recognized to demonstrate a malignant natural history. This report examines the results of combined transarterial embolization and surgical ligation and excision of complex intracranial arteriovenous dural fistulae (AVDF) in children.

METHODS: Two children ages ten and twelve years presented with a clinical picture of intractable headaches from early childhood. An AVDF associated with a posterior fossa nidus was present in patient 1 (age 10 years). Patient 2 (age 12 years) had a pseudotumor cerebri picture and intracranial venous hypertension with jugular stenosis, retrograde venous drainage and multiple AV fistulae. Both patients had high flow cortical venous drainage. Patient 2 had undergone prior optic nerve decompression and lumboperitoneal shunt insertion. Preoperative staged embolisation of the external carotid arterial feeders and selective intracranial feeders was performed. Patient 2 also underwent endovascular jugular angioplasty without change in the intracranial venous pressures. After a period of 48 hours patient 1 underwent craniotomy with clip ligation of the fistula components and resection of the abnormal nidus. Patient 2 underwent craniotomy with clip ligation of the multiple arteriovenous fistulous connections and resection of the transverse sinus with dura and tentorium cerebelli, in continuity. Follow up nine months.

RESULTS: Both children underwent immediate postoperative cerebral angiography which demonstrated complete obliteration of the fistulous connections. Both patients had an improvement in their headaches. Patient 1 suffered a focal seizure 3 months after operation without event. Patient 2 had a demonstrable decrease in size of the ventricular system.

CONCLUSIONS: Intracranial AVDF with cortical venous drainage in pediatric patients can be obliterated. The benefit is a reduction in intracranial venous hypertension headaches and protection from the risk of subarachnoid hemorrhage. Combining transarterial embolization to decrease the fistulous flow with surgical ligation and excision of the fistulae offers the maximum immediate benefit.

104. A Patient with Boston Craniosynotosis

Authors: Moise Danielpour, MD (Los Angeles, CA), John M. Graham, Jr., MD (Los Angeles, CA), Dawn L. Earl, MSN, NP (Los Angeles, CA), Ethylin W. Jabs, MD (Los Angeles, CA)

INTRODUCTION: In 1993, Warman reported a 3-generation family from Boston with variable expression of craniosynostosis. Linkage was established to 5q34-qter, where the MSX2 homeobox gene was mapped, using a polymorphism within the MSX2 gene. This mutant MSX2 product has enhanced affinity for binding to its DNA target sequence, resulting in activated osteoblastic activity and a dominant positive effect. We report a second patient with a cloverleaf skull anomaly who appears remarkably similar to patients pictured in the original report on Boston Craniosynostosis.

METHODS: Mutation analysis was preformed on the coding sequence of the MSX2 coding sequence using standard techniques.

RESULTS: Mutation analysis revealed a homozygous amino acid sequence change (T129M; ACG>ATG) within the coding sequence of MSX2, which is not within the homeodomain, and this change has previously been reported to be a benign polymorphism.

CONCLUSIONS: We present a child with Boston Craniosynostosis without a mutant MSX2 gene. Interpretation of the molecular findings remains unclear in light of the patient phenotype of Boston Craniosynostosis.

105. Cervical Syringodiastematomyelia

Authors: Sanjay N. Misra, MD (Dallas, TX), Dale Swift, MD (Dallas, TX)

INTRODUCTION: To report reversible syrinx formation in both hemicords, as a result of a trapped fourth ventricle, in the presence of a cervical split cord malformation.

METHODS: A 17 year old female had undergone myelomeningocele closure and ventriculoperitoneal shunt insertion after birth. For progressive thoracolumbar scoliosis,she underwent excision of a thoracolumbar diastematomyelia at the age of ten years. This halted the prgression of her scoliosis. During her childhood she also required multiple ventriculoperitoneal shunt revisions for shunt dependant hydrocephalus and shunt dysfunction. Five months following shunt revision for a shunt infection she presented with progressive gait deterioration, progressing to quadraparesis and bilateral sixth nerve palsies. All other cranial nerves were intact. Cranial computed tomography and magnetic resonance imaging demonstrated the presence of a trapped fourth ventricle. In addition a split cord malformation of the cervical cord was present with syrinx formation in both hemicords. A fourth ventricle shunt was placed.

RESULTS: Following insertion of the shunt there was clinical and radiologic improvement in the dimensions of the fourth ventricle. Concurrently, there was resolution of the syringodiastematomyelia.

CONCLUSIONS: Cervical syringodiastematomyelia can occur in the presence of a split cord malformation. This reversible syrinx formatiqn in both hemicords, responds as with other causes of syringomyelia, to the treatment of the increased intraaxial CSF pressure.

106. Cervical and Thoracic Dermal Sinus Tracts

Authors: Laurie L. Ackerman, MD (Iowa City, IA), Arnold H. Menezes, MD (Iowa City, IA),

INTRODUCTION: Cervical and thoracic dermal sinus tracts (DST) account for 1% and 10% respectively of all DST's. Few case reports describe this entity. We report nine cases; five cervical and four thoracic.

METHODS: Operative records from 1970 to present were reviewed to identify cases. Charts and radiographs were utilized for data collection. Information collected included patient demographics, presenting signs and symptoms, radiographic & operative findings, duration of follow-up and functional outcome.

RESULTS: Ages ranged from 3 days to 55 years. All cervical cases were females. Four cases <1 y/o presented with skin findings and no neurological deficit. Five cases >1 y/o presented with neurologic findings, with three having undergone previous extradural operative repairs as infants. Initial examination revealed changes in motor function (5), sensation (4), reflexes (5), gait (2), and altered bowel/bladder function (2). Six had skin findings including one infected tract, three had previously healed incisions, and two complained of back or neck pain. Seven had bifid spinous processes overlying the tract entry into dura. All patients were surgically explored. Operative findings included six buckled tethered cords, dural changes (opacified dura or frank arachnoiditis) in four, two tract CSF leaks, two diastematomyelias, and two intradural tumors (epidermoid & dermoid). Mean follow-up was 35 months. All infants remained neurologically intact. Four of five patients >1 y/o demonstrated improvement; one continued with a stable deficit. One local syrinx and one new-onset scoliosis developed during follow-up.

CONCLUSIONS: This first reported series of cervical and thoracic DST's highlights the need for close attention to skin lesions in infants, and consideration of retethering or tumor in patients with previous resections who deteriorate. Definitive operation including intradural exploration should be performed with the initial operation in an attempt to obviate future complications.

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107. Abscedation of Spinal Epidermoid Cysts in Children

Authors: Saleh S. Baeesa, MD,FRCSC (Jeddah, Saudi Arabia), Sadiq Ben Omer, MD (Jeddah, Saudi Arabia), Hani Azzouni, MD (Jeddah, Saudi Arabia)

INTRODUCTION: Congenital dermal sinus and epidermoid cyst are uncommon form of spinal dysraphism. Spread of infection to the spine in form of meningitis and spinal abscess remains the most serious complication that is associated with high morbidity and mortality rates. Rarely, there may be no external signs of sinus or infection, and their first presentation in a form of intramedullary spinal abscess. The review of the literature revealed sixteen cases, and most are under the age of five years.

METHODS: Two children less than 2 years of age had similar presentation of irritabiliy, rapid progressive paraplegia, and loss of sphincters control within 48 hours. There was no clinical or laboratory signs of infections elsewhere, and no external signs of dermal sinus. Magnetic resonance imaging demonstrated a tethered spinal cord with extensive intramedullary spinal abscess.

RESULTS: The children had emergency lumbar laminoplasty and myelotomy, and drainage of the abscess with complete excision of epidermoid cyst. The tethered cord was released and in one case a small terminal lipoma was found and was subtotally resected. They recieved 4 weeks course of intravenous antibiotics in the Postoperative period. Complete neurological recovery with return of sphincter control was acheived in the two children, and no organisms were isolated from the abscess.

CONCLUSIONS: Intramedullary spinal cord abscess may occur as a complication of congenital dermal sinus and epidermoid cyst with or without stigmata of dermal sinus. Such presentation is rare and carries a high morbidity and mortality. Early surgical excision of the dermal sinus and epidermoid cyst is the only prevention of this devastating neurological complication. The pathogenesis and management intramedullary spinal abscess were discussed and the literature was reviewed.

108. Tuberous Sclerosis Associated With Subependymal Giant Cell Astrocytoma, Bilateral Renal Angiomyolipomas, Liver Adenomas, Cardiac Rhabdomyoma, Pulmonary Lymphangioleiomyomatosis and Pelvic Endometrioma without Mental Retardation

Authors: Michael E.B. Kelly, MD (Saskatoon, Canada), Venkatraman Sadanand, MD, PhD (Saskatoon, Canada), Robert W. Griebel, MD, F.R.C.S.C. (Saskatoon, Canada)

INTRODUCTION: Tuberous sclerosis is a relatively common disease. We present a rare case of a patient with no mental retardation but with multiple hamartomas secondary to tuberous sclerosis.

METHODS: A 23-year-old female diagnosed with tuberous sclerosis at birth presented with adenoma sabeceum, infantile spasms without mental retardation, subependymal giant cell astrocytoma, multiple cortical tubers, bilateral renal angiomyolipomas, liver adenomas, cardiac rhabdomyoma, pulmonary lymphangioleiomyomatosis and a pelvic endometrioma. Tuberous sclerosis was also diagnosed in her sister but not in her parents.

RESULTS: The patient underwent magnetic resonance imaging of her brain. A small subependymal giant cell astrocytoma was found but was not treated surgically as she was asymptomatic. Multiple subependymal cortical tubers were seen. Computerized tomography, MRI and ultrasound scanning of the abdomen revealed bilateral angiomyolipomas, multiple liver adenomas and an endometrioma. Plain chest X-ray and CT scanning of the chest revealed a pneumothorax and lymphangioleiomyomatosis. A chest tube and pleurodesis were used in the management of the pneumothorax and lymphangioleiomyomatosis.

CONCLUSIONS: Tuberous sclerosis with multiple extra cranial lesions and normal cognitive function is a rare phenomenon. We present what we believe to be the first reported case of tuberous sclerosis associated with subependymal giant cell astrocytoma, bilateral renal angiomyolipomas, liver adenomas, cardiac rhabdomyoma, pelvic endometrioma and pulmonary lymphangioleiomyomatosis without mental retardation.

109. Neurotoxicity of Human Amniotic Fluid in Myelomeningocele

Authors: Matthew M. Pearson, MD (Nashville, TN), Patricia Commers, MS (Nashville, TN), Joseph P. Bruner, MD (Nashville, TN), Noel Tulipan, MD (Nashville, TN)

INTRODUCTION: Myelomeningocele is the most common congenital anomaly of the CNS. In the "two-hit" hypothesis, neurologic deficit occurs as vulnerable myelodysplastic structures suffer under exposure to toxic amniotic waste. The amniotic milieu, however, varies dramatically over time and between pregnancies. Amniotic fluid in myelomeningocele has unique protein and electrolyte compositions. This experiment was designed to measure neurotoxicity of amniotic fluid in myelomeningocele through lactate dehydrogenase (LDH) release in culture.

METHODS: Amniotic fluid between 24 and 27 weeks' gestation was obtained from 11 patients undergoing in-utero myelomeningocele repair. To remove background LDH, a batch-purification procedure was developed. Amniotic fluid was mixed with reactive-red agarose beads then centrifuged to precipitate LDH. Amniotic supernatant was aspirated. The beads were then washed to elute unbound protein. The combined fractions were used for culture exposure. Organotypic cultures of fetal rat spinal cord were established then rinsed to remove pre-existing LDH. The cells were then incubated in either amniotic fluid or saline. After 48 hours, all media was collected and LDH release assessed using pyruvate-reduction.

RESULTS: Batch purification of amniotic fluid reduced LDH background 85-95%. Total protein concentration assays showed near 100% recovery of amniotic proteins. Remaining LDH background was subtracted from post-exposure values. Mean adjusted LDH release ranged from 10.7 (s.d. = 10.7) to 29.9 (s.d. = 6.6) mU. Control explants averaged 5.5 (s.d. = 1.0) mU. Differences were statistically significant (95%C.I.) for all but one patient. Grouping gestational ages showed no time of peak toxicity, but all age groups had significant release compared to controls.

CONCLUSIONS: Batch-ligand adsorption of LDH is simple and effective, with application to a range of in-vitro studies. In this study, direct neurotoxicity was demonstrated in late second trimester amniotic fluid from surgically confirmed myelomeningocele pregnancies. These findings indicate that tissue damage may occur earlier than previously recognized. If so, early protection of myelodysplastic tissues, possibly through in-utero surgical repair, may provide long-term benefit.

110. Small Pituitary Stalk Lesions: Observations and Recommmendations

Authors: Kathryn M. Beauchamp, MD (Denver, CO), Michael H. Handler, MD (Denver, CO), Nicholas Foreman, MD (Denver, CO)

INTRODUCTION: Small lesions of the inferior hypothalamus and pituitary stalk may present with diabetes insipidus, with or without other endocrinopathy. Often they are felt to represent histiocytosis X, but other pathologic entities which require different forms of therapy are sometimes seen.

METHODS: Five patients with small pituitary stalk lesions and diabetes insipidus underwent open craniotomy for biopsy without attempt at total resection, for pathologic diagnosis to guide subsequent treatment. Another patient refused such a diagnostic procedure when an outside institution made a clinical diagnosis of hypophysitis based on imaging studies.

RESULTS: Four of the lesions proved to be Langerhans cell histiocytosis. They responded well to treatment and radiographically regressed. The endocrinopathies persisted. One patient had benign hypophysitis, with no further clinical progression of disease, and with resolution of abnormalities on MRI. The last, carrying a clinical diagnosis of hypophysitis, had explosive growth of a non-germinomatous germ cell tumor which was life-threatening at the time of her operation 6 weeks after presentation.

CONCLUSIONS: Small pituitary stalk or inferior hypothalamic lesions require tissue biopsy for correct diagnosis and treatment.

111. Occult Spinal Dysraphism: Proposed Surgical Criteria and Results

Authors: Monica C. Wehby, MD (Portland, OR), Patrick S. O'Hollaren, MD (Portland, OR), Jennifer Hume, PA-C (Portland, OR), Joanne Wallis, PNP (Portland, OR), Colleen Phillips, PA-C (Portland, OR)

INTRODUCTION: Occult spinal dysraphism is increasingly recognized by pediatric neurosurgeons and urologists. Because the MRI scan may appear unremarkable other than spina bifida occulta, diagnosis must often be made by history and physical exam alone. As a result, uniform surgical criteria are lacking.

METHODS: Of 66 children (age 3–18 yrs, mean 8.0 yrs) who underwent lysis of filum to untether the cord, 60 were followed for greater than six months (6–37 months, mean 13.9 months). Surgical criteria were 1) spina bifida occulta, 2) progressive bladder instability, 3) urological/nephrological evaluation to confirm neurogenic etiology, and 4) one or more of the following: bowel involvement (fecal incontinence/chronic constipation), lower extremity weakness, gait changes, reflex/tone abnormalities, sensory disturbances, scoliosis, orthopedic abnormalities, limb length discrepancy, or recurrent UTI's.

RESULTS: Urinary incontinence/retention resolved or improved in 53/54 (98%); fecal incontinence resolved or improved in 31/32 (97%); weakness (21/21), sensory abnormalities(9/9), and pain (21/21) resolved in all affected children; gait abnormalities (24/24) and scoliosis/lordosis (6/6) improved in all affected children. No child had worsening of symptoms, and no operative complications were encountered.

CONCLUSIONS: The above surgical criteria appear to be effective in selecting patients who benefit from this procedure.

112. Surgical Treatment of Tethered Cord Syndrome

Authors: Yasuko Yoshida, MD (Sendai, Japan), Reizo Shirane, MD (Sendai, Japan), Takashi Yoshimoto, MD (Sendai, Japan)

INTRODUCTION: The physiological differences in tethered cord syndrome with various combined lesions make untethering surgery more difficult. Thus, there still remain controversies concerning the surgical treatment of tethered cord syndrome.

METHODS: In this study, we retrospectively reviewed the surgical treatment and results of 148 patients with spina bifida. This study involves three groups: group A included 45 patients with asymptomatic spinal lipomas; group B included 82 patients with symptomatic spinal lipomas; group C included 22 patients with tethered cord syndrome after repairment of myelomeningoceles. All patients were performed by a complete neurological examination and urodynamic study pre- and postoperatively. We performed untethering, spinal conus reconstruction, and dural sac reconstruction with Gore-tex sheet for all patients. The median follow-up period was 63.4 months.

RESULTS: Post operatively, all patients in group A remain in an asymptomatic state. In group B, tethered cord syndrome appeared less than one year of age was observed in 34 patients (41.5%). The improvement rate in group B was 28.6% in neurogenic bladder, 78.9% in motor functions and 90% in pain relief. In group C, 41.7% in neurogenic bladder, 63.6% in motor functions and 87.5% in pain relief.

CONCLUSIONS: We conclude that the most effective therapy for tethered cord syndrome is prophylactic untethering in their early infancy. We also suggest that an adequate plan for patient's selection and meticulous surgical procedures are essential for the treatment of patients with tethered cord syndrome.

113. Tethered Cord Release in Infants: Outcome and Surgical Morbidity

Authors: Karl F. Kothbauer, MD (New York, NY), Alina Faktorovich, BS (New York, NY), George I. Jallo, MD (New York, NY), Linda Velasquez, MS (New York, NY), Fred J. Epstein, MD (New York, NY)

INTRODUCTION: The objective of this paper is to report the clinical profile, outcome, and morbidity of early tethered cord release in children up to one year of age with a cutaneous signature of closed spinal dysraphism.

METHODS: This is a retrospectively reviewed consecutive series. Data were obtained with chart review and telephone interviews with parents and treating pediatricians. Descriptive statistics were used.

RESULTS: Of 25 patients operated on between 1992 and 2001 sufficient follow-up data were available in 22. Skin findings were subcutaneous lipoma in nine, hemangioma in eight, a hairy naevus in four, and combinations of these with skin appendages, dimples, sinus tracts in the remainder. On MRI a low conus was found in 13 (L3 to S1), a signficant intradural lipoma in ten, a lipomyelomeningocele in six, and a diastematomyelia in two patients. A neurological deficit was present in six patients, a musculoskeletal deformity of the lower extremities in five, a spinal deformity in three, and evidence for sphincter dysfunction in ten. Twenty patients (91%) had no postoperative complications. Wound healing problems or cerebrospinal fluid leakage occurred in two patients (9%), requiring a second procedure. At a mean follow up time of 47.5 (range 4–91) months five patients (23%) had significant motor deficits, nine patients (41%) had sphincter dysfunction, including the need for intermittent catheterization and signficant renal disease.

CONCLUSIONS: The morbidity of tethered cord release in children under one year of age is similar to the same surgery in older patients. At long-term follow up a significant portion of these patients had sphincter dysfunction and motor deficits. The effect of surgery on the development of these patients remains to be determined.

114. Indications and Pitfalls of Absorbable Plating in Craniofacial Reconstruction: A Review of all Currently Available Systems

Authors: Eric R. Trumble, MD (Orlando, FL), Jogi V. Pattisapu, MD (Orlando, FL), Christopher A. Gegg, MD (Orlando, FL), Kay R. Taylor, ARNP (Orlando, FL), Amy J. Dean, RN (Orlando, FL)

INTRODUCTION: Absorbable plating has been the standard of care in rigid fixation of the growing skull since the complications of metal, including intradural migration, have been well-documented. Lactosorb was first introduced to the market in 1996 as the first user-friendly absorbable plating system. Since then, four other systems have been marketed with similar indications but slightly different formulations.

METHODS: Twenty-five patients, all of whom underwent craniofacial repair requiring rigid fixation, were evaluated in this trial, which began January 2000. The five different absorbable plating systems that are currently available were sequentially trialed for ease of use (by both the surgeon and the scrub), clinical absorption characteristics, appearance, cost, and complications/failures. All patients were followed a minimum of 9 months by the craniofacial team, consisting of a pediatric neurosurgeon, plastic surgeon, opthalmologist, and, when appropriate, oral surgeon. Pre-operative and post-operative head CTs with 3-D reconstructions were also assessed for bony alignment and growth.

RESULTS: There were 3 treatment failures noted in the twenty-five patients. One failure (Lactosorb/Lorenz) was due to bony resorption and early plate degradation. Two failures (one with Craniosorb/Codman and the other with Synthes) were due to inadequate fixation (in both cases, the bone was too thin to hold the planned plating system, forcing the use of the back-up absorbable plating system). Cost was highly variable due to contracting but all were ultimately within 20% of each other and Titanium plating, making this variable less important. Ease of use was high in all the systems (Lactosorb, Craniosorb, DeltaSystem/Stryker, and Macropore/Medtronic) except Synthes, which had a moderately complex insertion system. Appearance was similar with all the systems, although there was a bias by the team to use the lower profile plates.

CONCLUSIONS: There are many adequate absorbable plating systems currently on the market. However, care must be exercised with some of the systems if infants are in the patient population the surgeon serves. Cost should no longer impact the use of these systems and there are enough configurations within all for adequate cosmesis.

115. Reduction of Transfusion Rates in the Surgical Correction of Sagittal Synostosis

Authors: Stephen Hentschel, MD (Vancouver, BC), Paul Steinbok, MD (Vancouver, BC), D. Douglas Cochrane, MD (Vancouver, BC), John Kestle, MD (UT)

INTRODUCTION: As public concern about the risks of blood transfusions increased in the mid 1990s, avoidance of transfusions became a goal of surgery for sagittal synostosis. This study was performed to confirm a hypothesized reduction in transfusion rates in recent years and to identify factors associated with need for transfusion or low postoperative hemoglobin.

METHODS: Sagittal synostosis operations in children between 1986 and 1999 were reviewed retrospectively. Patients underwent a minimum of vertex strip craniectomy and parietal craniectomies. There were 118 patients, with median age at operation of 4.2 months. Two endpoints were chosen for analysis, firstly the rate of blood transfusion and secondly the rate of "hemostasis failure", defined as either the receipt of a blood transfusion or a post-operative hemoglobin <70g/L. Techniques to minimize blood loss since 1995 included: use of the Colorado needle for scalp incision, Midas Rex craniotome for cranial cuts, and microfibrillar collagen. Postoperative hemoglobin was allowed to fall to 60g/l if the child was stable hemodynamically, before giving blood. There were no cardiovascular or wound healing complications, and no repeat surgeries for cosmetic reasons.

RESULTS: 42% (95%C.I. 31%–52%) before 1996 and 11% (95%C.I. 0%–23%) since 1996 received blood. The reduction in blood transfusion rate in latter years was in part related to the acceptance of a lower post-operative hemoglobin, often below 70g/L. With univariate analysis the only patient/surgery factors that correlated with "hemostasis failure" in a statistically significant manner were year of surgery and extent of surgery. Logistic regression of age and weight of the child, surgery time (skin to skin), pre-operative hemoglobin, extent of surgery, and surgeon against Ïhemostasis failureÓrevealed that the best predictor of "hemostasis failure" rate was extent of surgery (=1.4, SE=0.44). Once extent of surgery was accounted for in the model, no other covariates significantly improved the model.

CONCLUSIONS: Low blood transfusion rates were achieved using simple intraoperative techniques and by accepting a low postoperative hemoglobin.

116. Results and Technical Aspects in Early Surgery for Craniosynostosis

Author: Hannes Haberl, MD (Berlin, Germany)

INTRODUCTION: Timing and extension of surgery continue to be a matter of discussion in current craniosynostosis management. In this retrospective review of 243 patients presenting for suspected craniosynostosis, we report particularly on our experience with early surgery in 83 cases.

METHODS: We did not establish a surgical indication in 158 children (65%), either showing a malformation without associated craniosynostosis (93/38%) or presenting with only mild clinical expression of sutural synostosis (65/27%). In 85 cases we established a surgical indication. Parents did not follow our recommendation in two cases. In 83 cases (34%), we performed a diagnosis-related standardized intervention. Demographic data, clinical follow up, and photo-documentation were examined.

RESULTS: After a mean follow-up of 3 years, we achieved satisfying results in 68 cases (82%). Of 15 cases (18%) with only limited improvement, two children were submitted to a second intervention. Further two children had to be reoperated early for insufficient hemostasis. Regarding very early (< 6 months) versus late surgery (> 6 months) within the first year of life, the largest subgroup of 47 children with sagittal synostosis showed similar long-term results in both groups. Most of the unfavourable results could be related either to inadequate adaptation of the surgical technique to the individual pronunciation of the malformation or to an important secondary loss of correction in multisutural synostosis.

CONCLUSIONS: In conclusion, the over-all results of surgery within the first year of life were satisfying in 82% without showing any further age dependency in the largest subgroup of sagittal synostosis. Standard procedures need to be adapted to the individual pronunciation of a craniosynostosis to avoid unfavourable results.

117. Delayed Onset of Vocal Cord Paralysis After Explantation of a Vagus Nerve Stimulator in a Child

Authors: Michael Vassilyadi, MD (Ottawa,), Richard H. Strawsburg, MD (Cincinnati, OH)

INTRODUCTION: Vagus nerve stimulation for the management of intractable seizure disorders is increasingly being used, especially in younger children. Although complications such as infection or vocal cord paralysis are uncommon, some may be unreported.

METHODS: A 3.5 year old boy with intractable complex partial and generalized seizures had a left vagus nerve stimulator (VNS) successfully implanted. Two weeks later, the cervical incision showed signs of infection. Wound culture identified the presence of Staphylococcus aureus and the child was started on intravenous Vancomycin. The infection was subsiding until 16 days later when purulent discharge was noted, along with looping out of the electrodes. The VNS generator and leads were explanted and antibiotics continued. The platinum electrodes were carefully removed off the vagus nerve, which was surrounded by abundant fibrous granulation tissue, under loop magnification.

RESULTS: Three weeks after explantation the child's mother noted a change in the voice of her son, as well as increased coughing and gagging. Flexible laryngoscopy identified a left vocal cord paralysis. The child's meals were thickened in order to diminish the possibility of an aspiration pneumonia. Six months later the child was back on his regular diet. Repeat flexible laryngoscopy showed resolution of the vocal cord paralysis.

CONCLUSIONS: Infection requiring explantation of a VNS is uncommon. The risk is higher in younger children, especially in those who are developmentally delayed. These children may continuously drool, with saliva or food soiling the fresh incision, or even pick at the incision to the point of twisting or even pulling out the electrodes. Less common is a vocal cord paralysis, especially occurring in a delayed fashion. Fortunately, it was temporary in this patient; his seizure disorder and the superimposed vocal cord paralysis placed him at a high risk for an aspiration pneumonia.

118. Preliminary Experiences with a Gravity-Regulated Valve

Author: Hannes Haberl, MD (Berlin, Germany)

INTRODUCTION: Overdrainage is one of the essential problems in the treatment of hydrocephlus by ventriculo-peritoneal shunting. Anti-siphon devices and flow-regulated systems diminish this effect to a certain extent. Vice versa these systems generate new problems like underdrainage or shunt-occlusion. Purpose of this study was to test a new valve, adjusting the opening pressure to the position of the body and thus preventing gravity-induced overdrainage.

METHODS: In 35 hydrocephalic pediatric patients with a clear indication for ventriculo-peritoneal shunting, we implanted a new valve, carrying a doublespring-loaded conventional mechanism combined with a gravity-controlled mechanism within a stable titanium housing. Due to the increase of the opening pressure in vertical position of body and valve and a corresponding decrease in horizontal position, gravity induced overdrainage should be prevented without causing underdrainage or occlusion. The children were followed up regularly within our neurosurgical consultation. Depending on the age of the children, the size of the ventricles was controlled by ultrasound, CT or MRI.

RESULTS: The Paedi-Gav Shunt was easy to implant because the small diameter of the round valve allows subcutaneous positioning together with the tube. There were no complications except two infections and one shunt occlusion within a mean follow up of 6 months. The radiological findings excluded overdrainage in all cases.

CONCLUSIONS: The Paedi-Gav Shunt seems to prevent successfully gravity-related overdrainage without restraining the necessary amount of liquor flow.

119. Posthemorrhagic Hydrocephalus in Prematurity and Extreme Prematurity: A Ten-Year Single Center Experience

Authors: Ray M. Chu, MD (Minneapolis, MN), Ramachandra P. Tummala, MD (Minneapolis, MN), Douglas Causer, MD (Minneapolis, MN), Therese O'Fallon, CANP (Minneapolis, MN), Mahmoud Nagib, MD (Minneapolis, MN)

INTRODUCTION: Intraventricular hemorrhage (IVH) and posthemorrhagic hydrocephalus (PHH) have profound impact on neonatal outcome. There has been limited information in the past on the impact of extreme prematurity (< 26 weeks) and extremely low birth weight (ELBW, < 1000 g) on IVH and PHH.

METHODS: We report a single-center, single-neurosurgeon experience with 788 premature (<36 weeks) infants with IVH from 1990 to 1999. A standard neurosurgical protocol of IVH treatment was devised and followed. The extensive neonatology database at Children's Hospital, Minneapolis was searched for all infants with the diagnosis of IVH. The hospital and clinic records of these infants were then reviewed. Factors thought to have an impact on IVH, PHH, cerebrospinal fluid shunting, and shunt infections were analyzed.

RESULTS: Of the 788 patients, 265 (34%) were extremely premature, and 325 (41%) had ELBW. The classification of IVH in this series was as follows: Grade I—377 (48%), Grade II—183 (23%), Grade III—124 (16%), and Grade IV—104 (13%). Ventricular access devices (VAD) were necessary in 473 cases (60%). Ventriculoperitoneal shunting (VPS) was performed in 79 patients (10%). Shunt complications occurred in 22 patients (2.8% cumulative, 28% relative). Risk factor and outcome analysis is pending.

CONCLUSIONS: Although extreme prematurity leads to numerous systemic complications that negatively affect outcome, the prognosis of IVH and PHH in this population is not as poor as previously thought. Advances in neonatal critical care and the development of VAD have made a profound impact on the treatment and improved survival in infants with PHH who cannot yet tolerate a shunt.

120. Endoscopic Management of Intraventricular Arachnoid Cysts

Authors: Tien T. Nguyen, MD (Syracuse, NY), Liliana Goumnerova, MD (Boston, MA)

INTRODUCTION: Although intraventricular arachnoid cysts are more common in children than in adults, they occur rarely. The authors report a series of 9 children with symptomatic intraventricular arachnoid cyst treated by endoscopic surgery.

METHODS: The patients were between the ages of 7 months and 13 years (mean 5 years). The presenting signs and symptoms consisted of macrocephaly, developmental delay, headache, seizures, opththalmoplegia, and motor weakness. The diagnosis of intraventricular arachnoid cyst was made from operative specimen or by preoperative computed tomography or magnetic resonance imaging. All children underwent endoscopic fenestration of the wall of the cyst, allowing communication with the ventricle.

RESULTS: The arachnoid cyst recurred in one child and a craniotomy was performed to successfully excise its wall. Another child required a second endoscopic, but definitive, operation. After a follow-up period ranging from 3 months to 5 years (mean 2 years), all of the patients presented with improvement of neurological symptoms or signs of intracranial hypertension.

CONCLUSIONS: Endocopic surgery is a safe and effective treatment of intraventricular arachnoid cyst.

121. Placement of Two Shunt Valves in Series as Therapy for Overdrainage

Authors: Dennis J. Rivet, MD (Saint Louis, MO), Jeffrey G. Ojemann, MD (Saint Louis, MO), T.S. Park, MD (Saint Louis, MO)

INTRODUCTION: Symptomatic overdrainage in patients with shunts is a common, challenging clinical problem. We present a series of patients treated with a novel arrangement of two shunt valves placed in series.

METHODS: Since January, 2000, eight patients underwent elective revisions of their shunt systems to place a Codman-Medos programmable valve followed in series by a low or medium pressure PS Medical valve as treatment for overdrainage symptoms. Symptoms had been refractory to multiple other shunt types and arrangements, alternative surgical interventions such as third ventriculostomy, as well as adjustment of the programmable valve. Patients ranged in age from 5 to 20 years (mean 13) and had undergone an average of 7 prior revisions. The cause of hydrocephalus was related to a temporal lobectomy for epilepsy in 1 patient, aqueductal stenosis in 1 patient, congenital in 4 patients, and myelomeningocele in 2 patients. Duration of follow-up was at least 12 months in all but one patient. In-vitro valve testing was performed utilizing a recognized laboratory protocol to generate pressure-flow performance curves.

RESULTS: All patients in the series had improvement of their symptoms. No patient has required shunt revision or admission to the hospital for symptoms related to the shunt. In-vitro testing data for these valve arrangements will be presented.

CONCLUSIONS: Placement of a standard low or medium pressure valve in series following a programmable valve represents a unique, effective, and safe alternative for patients with refractory overdrainage symptoms.

122. Neck Wrapping Reverses Shunted Low Pressure Symptomatic Ventriculomegaly

Authors: Patrick J. Connolly, MD (Indianapolis, IN), Rajesh K. Bindal, MD, Thomas G. Luerssen, MD, Joel C. Boaz, MD

INTRODUCTION: Neck wrapping has been previously described to ameliorate "symptomatic ventriculomegaly" in a patient with a functioning shunt. (1) This technique has been proposed as an alternative to prolonged subatmospheric external ventricular drainage.

METHODS: In this report we discuss a series of five patients whom we treated with neck wrapping following shunt revision for proximal malfunction or infection. After revision, each patient remained persistently symptomatic and continued to show ventriculomegaly. Clinical investigations determined that the shunts were functioning as intended. Four patients had been changed to antisiphon shunts as part of their revision.

RESULTS: Each patient was treated with neck wrapping. All patients had clinical improvement within 48 hours. Four patients had radiographic improvement within 72 hours and sustained improvement in 18 to 72 month follow up. One patient had persistent ventriculomegaly and recurrence of symptoms within one month of neck wrap removal. Symptoms resolved after valve revision.

CONCLUSIONS: Neck wrapping appears to have clinical utility for managing low pressure hydrocephalus in the face of symptomatic ventriculomegaly and a functioning shunt. Radiographic resolution of ventriculomegaly after neck wrapping predicted therapeutic success. Use of this technique may spare a select group of patients from multiple shunt explorations or prolonged external ventricular drainage.

123. Use of Frameless Stereotaxy System (Accupoint*) in Placement of Ventriculoperitoneal Shunt

Authors: S. Basu, FRCS, P. Byrne, C. Mallucci, FRCS, P. May, FRCS, P. Eldridge, FRCS

INTRODUCTION: Suboptimal placement of ventricular catheter is the principal cause of early failure of ventriculo-peritoneal shunts. Kast J et al 1994 reviewed 128 consecutive patients concluding that more than 50% of failures within 2 years are due to proximal blockage because mal position. Though in majority of situations a free hand placement of ventricular catheter is adequate, the probability of an optimal placement decreases with narrower ventricles. Frame-based stereotaxy has been used to access narrow or normal sized lateral ventricles (Tulipan et al 1998) but its routine use is cumbersome because of the need to image with frame in place and the inconvenience of having to perform the distal implantation past the frame. Frameless image guided systems provides a user-friendly and practical alternative but lacks the stability of a rigid system. The Accupoint* system is an attachable rigid arm with a ball and socket joint mounted localiser using image guided navigation. The Accupoint* amalgamates the practicality of a frameless system with the advantages of the rigid frame in planning and placement of the ventricular catheter in optimum position and trajectory.

METHODS: We describe our experience of using Image guided system and Accupoint in placement of ventricular catheter in eight patient with narrow or slit ventricles since January 2000.

RESULTS: The longest continuing revision free period is 18 months in a patient who has 5 revisions in previous 6 months before Accupoint* assisted placement of proximal catheter. We discuss our technique and outcome and compare the result with optimality of freehand placed shunt during the same period.

CONCLUSIONS: Accupoint is a useful tool for optimal shunt placement specially cases where ventricular access may be difficult.

124. The Seldinger Technique for Multiloculated Ventricles and Difficult Shunt Placements

Authors: Cornelius H. Lam, MD (Minneapolis, MN), Darren S. Lovick, MD (Minneapolis, MN)

INTRODUCTION: Multiloculated hydrocephalus is one of the most difficult maladies a pediatric neurosurgeon is faced with. The compartmentalization of the ventricle sometimes requires multiple intra-ventricular catheter and valve systems. Endoscopy allows for simplification of some of these systems. Nevertheless, accurate placement of shunts remains a difficult technical feat.

METHODS: The Seldinger technique is used. A rigid scope with a channel is guided into the cyst using standard intraventricular landmarks. A soft filiform wire is inserted through the channel. The scope is withdrawn and a ventricular catheter that has been fish-mouthed is slid down the wire. The remainder of the shunt is inserted in the usual fashion.

RESULTS: We have not encountered any neurologic compromise from this technique. Limitations have been due to visualization of landmarks. Bleeding was not an concern as originally postulated.

CONCLUSIONS: The resolution of the intracatheter endoscope (Neuropen) remains low, making navigation in distorted anatomy difficult. By combining the superior optics of a rigid glass rod endoscope with an idea that came to Sven-Ivar Seldinger in an "attack of common sense", the neurosurgeon has an additional technique in their armamentarium to care for these difficult cases.

125. Shunt Failure After Posterior Fossa Decompression

Authors: Jogi V. Pattisapu, MD (Orlando, FL), Christopher A. Gegg, MD (Orlando, FL), Eric R. Trumble, MD (Orlando, FL), Kay Taylor, ARNP (Orlando, FL), Amy Dean, RN (Orlando, FL)

INTRODUCTION: Within the past 18 months, we have identified several cases in which ventriculoperitoneal shunts failed soon after undergoing posterior fossa decompression. Adequate shunt function was confirmed in all cases prior to the posterior fossa surgery. Suboccipital decompression was performed on 9 patients with ACM II and hydrocephalus, and of these, 4 patients experienced shunt malfunction within 3 weeks of the operation.

METHODS: The mean age of the 4 children who experienced shunt failure was 73.5 months, and 47.5 months for the 5 control patients. The average time of shunt failure after posterior fossa surgery was 21 days (range 11–35 days). One patient required posterior fossa exploration and repairing the graft at the time of shunt revision. There were no cases of shunt infection after the posterior fossa decompression in this series.

RESULTS: Several causes may be considered for shunt failure after posterior fossa decompression. Age, persistent CSF leak with collapsed ventricles, altered CSF flow dynamics, blood/debris within the ventricular system, and insidious shunt infections are factors which may be implicated in these cases. In all cases, however, adequate shunt function was confirmed prior to the posterior fossa decompression.

CONCLUSIONS: The possibility of shunt malfunction after posterior fossa decompression needs to be considered as the CSF dynamics are altered by the procedure. Since ventriculoperitoneal shunt malfunction occurs more frequently than previously considered following posterior fossa decompression, this potential risk needs to be considered in patients undergoing the procedure.

126. Cerebellitis Mimicking Cerebellar Neoplasia

Authors: Ibrahim A. Omeis, BS (Burlington, VT), Sami Khoshyomn, MD (Burlington, VT), Steven P. Braff, MD (Burlington, VT), Todd A. Maugans, MD (Burlington, VT)

INTRODUCTION: Cerebellitis of childhood is a self-limiting disease amendable to conservative management, rarely requiring surgical intervention. We present the case of a 16 year-old female with diffuse right-sided cerebellar swelling, brain stem compression, and mild hydrocephalus that required surgery for diagnostic and therapeutic purposes.

METHODS: A unique case is reported to illustrate the complexities in diagnosis and management of a unilateral cerebellar process producing brainstem mass effect and cranial neuropathy. A review of the clinical, radiological, and therapeutic features of cerebellitis is also presented.

RESULTS: A 16-year old girl presented with a 3-month history of worsening right temporal and retroauricular headaches. Later, she developed gait ataxia, increasing somnolence, vomiting, and diplopia that prompted admission to the hospital. On examination, she was also noted to have a right third division trigeminal neuralgic pain, and right-sided dysmetria on finger to nose testing. MRI of the brain showed a diffuse right cerebellar lesion with folial enhancement and significant mass effect. MR spectroscopy demonstrated an increase in Choline to Creatine ratio suggestive of neoplasia. The radiological differential diagnosis included primary cerebellar neoplasia and Lfhermite-Duclos syndrome. Laboratory evaluation was significant only for an elevated INR and factor VII deficiency. Due to the significant mass effect and the undetermined etiology, she was taken to the OR for biopsy and decompression. Intra-operatively, the right cerebellar hemisphere was enlarged with widened gyri and increased pial microvascularity. Histopathological evaluation of the biopsy specimen showed meningeal and perivascular chronic lymphocytic inflammation. The patient had immediate post-operative relief of pain. She was subsequently treated with oral steroids and manifested a complete neurological recovery. Follow up imaging showed resolving cerebellitis and post-inflammatory atrophy.

CONCLUSIONS: This case illustrates the diagnostic and therapeutic challenges presented by lesions in a patient with protracted symptoms. In addition for neoplastic, vascular, infectious, and dysplastic lesions, inflammatory processes must also be considered. In rare cases, surgical decompression may be required to manage chronic cerebellitis.

127. Non-infectious Causes of Ventriculitis

Authors: Michael D. Medlock, MD (Boston, MA), Amanda Yaun, MD (Washington, DC)

INTRODUCTION: Not all shunt related inflammation is infectious.

METHODS: A twin survived neonatal meningitis with Enterobacter sakazakii. At 4 months she developed hydrocephalus and a ventriculoperitoneal shunt was inserted. At 6 months her shunt was temporarily removed due to a Staphylococcus epidermidis shunt infection with a mild inflammatory reaction. At 7 months a fractured proximal shunt catheter was replaced. CSF was sterile on culture with normal protein, glucose and cell counts. Following surgery she developed Clostridium difficile gastroenteritis. Persistent fevers prompted a shunt tap one week later and a new shunt infection with Enterobacter cloacae was diagnosed. Only one culture was positive. Over 4 weeks and multiple ventriculostomies, the protein remained greater than 2 grams, the glucose low, and the white count high. She developed septated ventricles and required multiple ventriculostomies despite negative cultures. At 8 months her 2 ventriculostomies were removed and she was discharged. The process of septation progressed requiring CT-guided aspiration of several ventricular regions yielding only sterile fluid. She became more irritable with inconsolable crying that required benzodiazepines and narcotics as an outpatient.

RESULTS: Histological evidence of an allergic reaction to silicon (eosinophils and giant cells in tissue surrounding shunts) has been found in 10% of patients who had shunts removed for various reasons. These patients seem to have more frequent shunt revisions. Light and transmission electron microscopic evidence shows that non-infected shunt catheters may contribute to shunt malfunctions by causing reactive changes, such as glial and ependymal proliferation, in periventricular tissue. Sterile solutions of bacterial peptidoglycan polysaccharides have been shown to contribute to chronic inflammation in numerous animal models.

CONCLUSIONS: This case report and a review of the literature demonstrate that shunt materials allergies, microscopic brain trauma, and bacterial subcomponents can contribute to progression of inflammation despite prompt sterilization of the CSF. Steroids should be considered for therapy.

128. Case Report of Two Brain Abscesses in Infancy

Authors: Muralidhara R. Raju, MD (Syracuse, NY), James W. Holsapple, MD (Syracuse, NY), Satish K. Krishnamurthy, MD (Syracuse, NY)

INTRODUCTION: Objective and Importance Infant brain abscesses without preceding trauma, congenital heart disease or meningitis are uncommon. Nevertheless, the consequences of delaying the diagnosis are devastating. Therefore, it is important to be able to quickly and accurately recognize this condition. We review two cases of infant brain abscesses emphasizing clinical presentation.

METHODS: Clinical Presentation Case 1: A 4-month-old boy born prematurely (28 weeks gestation) presented with 2 weeks of irritability and increasing head circumference. There was no fever, seizures, weakness or meningeal signs. CT scan showed large left hemispheric multi-loculated mass. There was peripheral leukocytosis. The provisional diagnosis was intracranial tumor. Case 2: A 10-day-old boy with jaundice presented with 1 day of focal motor seizures. There was no fever, meningeal signs or weakness. CT scan showed left temporoparietal edema and bilateral cerebellar lesions. Lumbar puncture was normal. There was peripheral leukocytosis.

RESULTS: Intervention Both patients underwent CT and MRI scans. Surgical drainage of the lesions was performed in both and was followed by intravenous antibiotic therapy. The organisms isolated were streptococcus salivarius in case 1 and proteus in case 2.

CONCLUSIONS: Brain abscesses in infancy can occur without preceding trauma, congenital heart disease or meningitis. Presentation is less dramatic in infants and may not include fever or meningeal signs. Neurologic signs such as focal deficits are often minimal and non-specific. Lumbar puncture is typically not useful. Steroids for a presumed tumor would lead to catastrophic rupture of abscess into ventricles. For these reasons urgent CT scanning is essential for correct diagnosis and appropriate treatment.

129. Surgical Treatment of Cavernous Malformations in Children

Authors: David H. Harter, MD (Valhalla, NY), John A. Grant, MD (Chicago, IL), Tadanori Tomita, MD (Chicago, IL), Bowman M. Robin, MD (Baltimore, IL), DiPatri J. Arthur, MD (Baltimore, MD), McLone G. David, MD (Chicago, IL)

INTRODUCTION: From January 1987 to June 2001, 21 children underwent surgical removal of cavernous malformations at Children's Memorial Hospital in Chicago and the University of Maryland in Baltimore. The authors review the presentation, surgical indications and outcomes for their combined institutional series.

METHODS: All available pertinent patient records and imaging were reviewed retrospectively. Patients were evaluated with routine CT and MR imaging, four underwent conventional catheter angiography. Frameless stereotaxy was used in twelve cases, intraoperative ultrasound in ten.

RESULTS: A total of 21 patients underwent 22 neurosurgical procedures for the removal of 23 lesions. Age ranged from 1.5 to 18 years, the average was 8.1. There were twelve boys and nine girls. A majority (54%) presented with seizures, the remainder with focal neurological deficit or headache. Fifteen of the lesions were cortical, four were pontine. There were no operative mortalities. Complete resection was confirmed by MR in all cases. One patient with multiple lesions had worsening of a pre-existing seizure disorder. One patient with a large interhemispheric cavernoma subsequently required placement of a ventriculoperitoneal shunt. One patient with a small lesion in the floor of the fourth ventricle had protracted emesis postoperatively.

CONCLUSIONS: Supratentorial cavernous malformations were removed with minimal morbidity and no mortality. Frameless stereotaxy and intraoperative ultrasound were useful in the planning of small craniotomy flaps and confirmation of complete resection. Pontine lesions were technically more challenging, although no permanent neurological defecit resulted from their extirpation. The indications for removal of these lesions remain to be completely defined.

130. Intramedullary Spinal Cord Cavernous Angioma: A Pediatric Series

Authors: Mahmoud G. Nagib, MD (Minneapolis, MN), Therese O'Fallon, CANP (Minneapolis, MN)

INTRODUCTION: Intramedullary spinal cord cavernous angiomas are uncommon lesions. Only three to five percent of cavernous angiomas of the central nervous system involve the spinal axis.

METHODS: One hundred ten cases of intramedullary spinal cord cavernous angiomas have been identified in the literature. Seven patients were under 18 years of age when diagnosed. We have added our own two patients for a total number of nine patients. This group of children was the subject of review.

RESULTS: No gender dominance was identified. The ages ranged from eight to 17 years. Follow-up, when reported, ranged from 12 months to 87 months. The cervical and thoracic spinal cord segments were equally involved. Only one patient presented with a lumbar lesion. Only one patient presented with a lesion extending over two spinal cord segments. The MRI was used for diagnosing all patients but one. It is unclear how many patients underwent postoperative imaging studies. When reported, the lesion was described as posteriorly located except in one case. The latter (our own) was approached through a combined posterolateral and transpedicular route. No significant postoperative deformities were reported. Seven patients were clinically improved. Two remained unchanged. Both adults and children have no clear gender dominance. However, in contradistinction to adults, the overwhelming majority of pediatric patients presented with an acute onset of significant neurologic deficits with a relatively rapid deterioration. The children appear to carry a more favorable postoperative prognosis, as compared to their adult counterparts, despite severe preoperative deficits. Due to the relatively high cumulative risk of hemorrhage, these lesions carry a high mortality.

CONCLUSIONS: Symptomatic and/or minimally symptomatic lesions in relatively accessible locations should be considered for surgical extirpation. The approach should be tailored to the lesion location. The likelihood of delayed spinal deformity is higher in the pediatric age group, hence the need for long-term follow-up and prompt stabilization.

131. Dural-Based Tumors in Children: A Wide Range of Unusual Pathology

Authors: Hemant Sarin, MD (Denver, CO), Michael H. Handler, MD (Denver, CO)

INTRODUCTION: It is unusual for children to develop tumors adherent to the dura, which in adults are most typically meningiomas. While meningiomas can occur in children, we have seen a wide variety of other tumors which share some of their radiographic features.

METHODS: We review the pathology and radiographic findings of nine patients with dural-based tumors.

RESULTS: Three patients had histopathology consistent with meningioma. Two patients had primitive neuroectodermal tumors (medulloblastoma and neuroblastoma). The others each had a clear-cell cerebral ependymoma, an atypical juvenile pilocytic astrocytoma, a desmoplastic infantile ganglioglioma, and a low-grade sarcoma.

CONCLUSIONS: Dural-based neoplasms in the pediatric population are unusual. They appear to span a broader spectrum of pathology than is typically seen in adults. This must be recognized in planning the optimal surgical management of these tumors.

132. Surgical Treatment of Intramedullary Spinal Cord Tumors in Children

Authors: Francesco Sala, MD (Verona, Italy), Albino Bricolo, MD (Verona, Italy), Franco Faccioli, MD (Verona, Italy), Elisabetta Bassi, MD

INTRODUCTION: The management of pediatric intramedullary spinal cord tumors, especially astrocytomas, remains controversial. To favor aggressive vs. conservative treatment appears to be a standard recommendation for ependymomas but only an option for astrocytomas.

METHODS: From a series of 300 consecutive spinal cord tumors operated on during an 18-year period by the senior author (A.B.), we reviewed clinical, neuroradiological and treatment-related data of 40 patients less than 16 years of age. Tumors included 20 astrocytomas, 6 ependymomas, and a minority of other lesions. Functional status (FS) (McCormick Scale) was assessed pre-operatively, on discharge and at a mean follow-up of 2 years.

RESULTS: The most common location was the thoracic spinal cord where tumors appeared at a significantly higher age (12.2 yrs.) ($p=0.0055$), and after a significantly longer clinical history (51.8 months) ($p=0.0084$), compared to cervical (8.1 yrs, 14 months) and lumbar (7 yrs., 19.7 months) locations. Age did not correlate ($p>0.05$) with histology neither with surgical removal. Total removal was achieved in 29/40 children (72.5%): 83% of ependymomas vs. 60% of astrocytomas ($p>0.05$). At discharge, 70% of the children presented with a functional outcome unchanged or improved compared to the pre-operative status. The rate of total removal was significantly higher (100%) ($p=0.045$) in those children with an improved FS at the 2-year follow-up vs. 66% of those with an unchanged FS and 50% of those with a worsen FS, compared to the pre-operative FS. Six patients presented clinic and MR imaging evidence of recurrence within the same follow-up period.

CONCLUSIONS: In children, like in adults, most intramedullary spinal cord tumors are amenable to surgical treatment; neurological morbidity is mostly transient and appears n to be impaired by a more aggressive tumor removal.

133. Pediatric Diffuse Brain Stem Gliomas: What is the Best Management?

Authors: Muhammad Jalaluddin, MD, FRCS (Phoenix, AZ), Allen M. Kaplan, MD (Phoenix, AZ), S. David Moss, MD (Phoenix, AZ), K. Manwaring, MD (Phoenix, AZ), Micheal A. Lawson, MD (Phoenix, AZ), Daniel J. Bandy, MS (Phoenix, AZ)

INTRODUCTION: The management of diffuse brain stem gliomas are difficult Neuro-oncology problem. The purpose of this study is to determine the factors which can improve the survival of children with diffuse brain stem gliomas.

METHODS: We studied 10 children ages 2–13 years who were diagnosed with diffuse brain stem gliomas. All had MRI Scan of the brain with and without gadolinium enhancement. Five had PET scan of the brain with FDG and C11 methionine. Six were treated with radiation therapy alone. Two were treated with surgery and radiation. One was treated with radiation and chemotherapy. One had endoscopic biopsy and one was observed without any treatment. All children were regularly followed in the Neuro-oncology clinic with surveillance MRI Scan.

RESULTS: Four (40%) of 10 children died. The minimum survival was 8 months and maximum survival was 22 months. All 4 were treated with radiation therapy and 1 had chemotherapy in addition to radiation. Six (60%) children are still surviving. The minimum follow-up was 1 month and maximum was 44 months. Two were treated with surgery and radiation. Two were treated with radiation alone. One had endoscopic biopsy and one was observed without any treatment. Six children had PET Scan, which demonstrated increased protein metabolic activity in 3, increased glucose metabolic activity in 3 and 3 had minimum protien and glucose metabolic activity.

CONCLUSIONS: The management and prognosis of diffuse brain stem glioma remains complex and challenging. Although our series is small and follow-up is limited, the combination of surgery and radiation therapy may improve survival. The PET Scan is a useful tool for initial assesment of metabolic activity of brain stem gliomas and may predict outcome. It also be utilized for further evaluation of the response of different treatment modalities.

134. Neurofibromatosis Type 1 and the Pediatric Neurosurgeon

Authors: Jean-Pierre Farmer, MD (Montreal, Canada), Saad A. Khan, MD (Montreal, Canada), Asad Khan, PhD (Montreal, Canada), June Ortenberg, MD (Montreal, Canada), Carolyn Freeman, MD (Montreal, Canada), Jose Montes, MD (Montreal, Canada)

INTRODUCTION: Neurofibromatosis type 1 (NF1) children at many centers undergo frequent, costly surveillance scanning for a variety of asymptomatic CNS lesions. The natural history of these lesions is still poorly understood.

METHODS: We performed a 20-year retrospective chart review of 24 clinically proven NF1 patients who required surgery (group A) contrasted this cohort with 100 NF1 patients who did not require surgery (group B).

RESULTS: Group A patients underwent surgery for symptomatic/radiologically progressive lesions including neurofibromas, intracranial gliomas and moya moya, with 54% undergoing multiple procedures for more than one lesion ($P = 0.043$, $N = 24$). Group A patients were further distinguished from group B by exhibiting a greater number of non-optic intracranial tumors ($P = 0.007$), cranial nerves ($P = 0.000$), paraspinal ($P = 0.064$), craniofacial ($P = 0.001$), and visceral ($P = 0.03$) neurofibromas, and moya moya ($P = 0.00$), as well as higher frequency of seizure disorder, sphenoid wing dysplasia and poor academic performance. Gadolinium enhancement occurred in 43% optic gliomas, 50% parenchymal gliomas, 100% cranial nerve, 100% plexus, 67% paraspinal, 50% cranifacial and 50% visceral neurofibromas in group A, while only one group B tumor enhanced. In group A radiological progression occurred since initial diagnosis after 4 years for optic gliomas and cranial nerve, plexus and visceral neurofibromas, after 2 years for paraspinal neurofibromas and brainstem gliomas, and after 2.7 years for craniofacial neurofibromas. Only one tumor progressed in group B.

CONCLUSIONS: NF 1 patients who require surgery represent a phenotypically, and perhaps genotypic ally, distinct set of patients. Reduced frequency of surveillance imaging could result in significant healthcare cost savings. We recommend imaging for asymptomatic, gadolinium enhancing lesions every 4 years for optic pathway and parenchymal gliomas, cranial nerve, and visceral neurofibromas, and every 2 years for brainstem gliomas and paraspinal and craniofacial neurofibromas.

135. Profound Transient Visual Disturbance and Autistic Features Associated with Post-operative Cerebellar Mutism: A Confirmatory Case

Authors: Stacie Daniels, MD (Washington, DC), Leon Moores, MD (Washington, DC), Marc P. DiFazio, MD (Washington, DC)

INTRODUCTION: Cerebellar mutism is an uncommon complication of posterior fossa surgery. Speech impairment is most commonly seen, but behavioral difficulties can be associated, and may mimic those seen in autistic individuals. Symptoms are independent of recognizable cortical injury, with variable recovery. Transient visual disturbance in cerebellar mutism has only been reported once previously. We report a case that confirms this unusual manifestation, in association with a constellation of behavioral abnormalities reminiscent of autistic spectrum disorders.

METHODS: Our patient is a 7-year-old male with a one-month history of headache and gait disturbance. He was previously well, with normal growth and development. Examination demonstrated a normal mental status, with findings on neurologic examination consistent with cerebellar dysfunction. There was no papilledema. Neuro-imaging demonstrated a large, enhancing midline cerebellar tumor, with mild hydrocephalus. Gross total resection was uncomplicated, and histologic examination demonstrated medulloblastoma. Immediately post-operatively, the patient had profound visual inattention, with absent fixation, and no blink to confrontation. Neuro-ophthalmologic examination was significant for absent optokinetic nystagmus and normal pupillary responses and eye movements. Behavior was markedly abnormal, with vocalizations limited to screams, and periods of agitation punctuated by placidity. The patient did not follow commands, or appear to understand language. MRI demonstrated cerebellar edema, without brainstem or cortical abnormalities. Diffusion weighted MRI showed no evidence of ischemia. EEG was normal.

RESULTS: Over several weeks the patient began to attend briefly to faces and visual stimuli, with continued profound expressive language dysfunction. Slow recovery ensued, and within 4 months of surgery, the patient's vision was normal. Expressive and receptive language functioning had improved dramatically, although minimal dysarthria remained. Behavior also improved, with a return to the patient's previous social and emotional baseline.

CONCLUSIONS: This patient demonstrated profound post-operative cerebellar mutism, including the unusual association of visual disturbance and behavioral abnormalities reminiscent of autistic spectrum disorders. The case expands the pre-operative counseling obligations for such patients, and should prompt further study regarding the contribution of the cerebellum to cognitive, social and visual functioning.

136. A Bone and Cable "Girth Hitch" Technique for Atlantoaxial Fusions in Pediatric Patients: Technical Report

Author: Douglas L Brockmeyer, MD (SLC, UT)

INTRODUCTION: Traditional posterior atlantoaxial fusion techniques are inadequate to augment C1-2 transarticular screw fixation in very young children. A new technique for performing a posterior rib and multi-stranded cable atlantoaxial fusion is described.

METHODS: Two patients, one 18 months old and the other 24 months old, underwent posterior C1-2 transarticular screw fixation with a new "girth hitch" rib and cable fusion construct. The "girth hitch" cable construct holds the rib grafts solidly against the atlantoaxial complex with little or no chance of graft dislodgement or spinal canal compromise. A detailed description of the surgical technique will be supplied.

RESULTS: Both children went on to successful fusions within 3 months of surgery without the aid of an external orthotic device. They have been followed for 1 and 1 1/2 years, respectively. They continue to be monitored for evidence of spinal deformity.

CONCLUSIONS: The posterior rib and cable "girth hitch" fusion technique is a new and valuable adjunt to C1-2 transarticular screw fixation in very young children.

137. Hemorrhagic Complications of Intracranial Pressure Monitors (ICPM) in Children

Authors: Martin Blaha, MD (Seattle, WA), Daniel A. Lazar, MD (Seattle, WA), H.R. Winn, MD (Seattle, WA), Saadi Ghatan, MD (Seattle, WA)

INTRODUCTION: ICP monitoring plays a valuable role in the management of pediatric head injury and post-operative neurosurgical care. The purpose of this study was to investigate the incidence of hemorrhage after ICPM insertion, and classify these complications in a clinically relevant manner.

METHODS: Hospital charts of 431 children (ages 0–16) admitted to a Level I trauma center over a 2 year period were reviewed and 112 patients (134 insertions) who underwent intraparenchymal ICP monitoring were identified. Post-operative neuroradiological studies were reviewed by the authors.

RESULTS: ICPM insertion was performed 119 times without any hemorrhage (Grade 0). In ten children, a small punctate hemorrhage or localized subarachnoid hemorrhage (SAH) (Grade 1) occurred. Three patients sustained an extra-axial hematoma or diffuse SAH that did not require evacuation or manifest as a new neurological deficit (Grade 2). There were no hemorrhagic complications that necessitated evacuation or resulted in a noticeable change in the patient's clinical condition (Grade 3).

CONCLUSIONS: We propose a new grading system for hemorrhage after ICPM insertion. We found a complication rate close to 10% in pediatric patients. Fortunately, the majority of these hemorrhages were clinically silent and no neurosurgical intervention was necessary. However, Grade I and II hemorrhages may manifest with higher ICPs, and the long term consequences of these complications are not known. Of note, only 23% of these complications were reflected in the patient's charts, which may explain the low reported complication rate in other studies that did not analyse post-operative neuroradiological studies.

138. Experience in the Use of Frameless Image Guided Surgery and Advanced 3-D Image Visualisation Techniques in a Paediatric Neurosurgical Practice

Authors: Paul R. Eldridge, FRCS, Patricia Byrne, MSc (Liverpool, England), Paul May, FRCS, Conor Mallucci, FRCS (Toronto, OR), V. Accomazi, (Toronto, OR)

INTRODUCTION: We describe our experience of using neuronavigation system in a paediatric setting.

METHODS: Since 1995 frameless image guided surgery has been used for intra-operative neuronavigation in this unit. During this time 44 paediatric cases were operated on using this technique. The case mix comprised 36 intracranial tumour; 2 resections for epilepsy, 3 shunt placements, 2 biopsies and one arteriovenous malformation. Initial experience was using a mechanical arm system (ISG Viewing Wand) but more recently an infra-red localising system was employed (SNN Inc). Over time the system was upgraded, with the inclusion in the software of trajectory planning and image fusion. The neuronavigation system was easy to use with the additional theatre set-up time averaging 10 mins. Even with the use of advanced visualisation techniques, pre-operative analysis could be accomplished in approximately 30 mins. 6 cases were performed using a microscope with head-up display showing the virtual contouring of a tumour, following 3-D reconstructions of the tumour pre-operatively. Although for the majority of cases anatomical landmarks and a surface fit was used for registration (because of ease of use and convenience) in 3 cases, all involving posterior fossa tumours, fiducial markers were applied to the skin. In this area this approach achieved a better accuracy. Most recently advanced 3-D visualisation techniques have been used—in particular volume rendering using a variation in the opacity to display relationships between tumours and internal cerebral vasculature, and the use of "fuzzy segmentation" techniques to display the anatomy of vascular lesions and achieve 3-D brain renderings. The pre-operative use of such visualisations was felt to be as useful as the intra-operative image guidance.

RESULTS: None

CONCLUSIONS: None

139. Dynamic Response Of Three Layers In Pediatric Calvarial Prosthesis

Authors: Hun K. Park, MD, PhD (Detroit, MI), Manuel Dujovny, MD (Detroit, MI), Jong B. Lee, MS (Detroit, MI), Fernando G. Diaz, MD PhD (Detroit, MI)

INTRODUCTION: Previous investigations on calvarial trauma have shown that newborns and young children have soft, pliable skulls. However, the flexibility and displacement of the young calvarial are not sufficient to avoid brain injury when there is a large cranioplasty. Trauma can result in cranial depression even without fracture, which is so-called "Ping-Pong ball" injury. In this study, the behavior of calvarial prosthesis upon injury was evaluated using dynamic finite element analysis.

METHODS: In order to run explicit non-linear finite element analysis, single layer of elastic shell element model was rebuilt using 3 layers of solid element which is consist of inner and outer layers of compact bone and middle sponge bone as control model. Polymethylmethacrylate (PMMA) and Hydroxyapatite (HA) were applied as inner and outer layer and high-density polyethylene (HDPE) was used as middle layer in experimental model. Elastic-plastic solid elements, PAM-Crash material type 1, were used to model. The impact ball (450 gram) from 1 m height was imposed as elastic shell elements. The overall model consisted of 4740 nodes, 2168 solid elements and 4736 shell elements.

RESULTS: The result provided PMMA implant with middle HDPE revealed 1.78 KN of impact force compared to control (2.84 KN). Even though it allowed less impact force, central displacement increased to 4.48 mm, which is 3 times larger than HA implant (1.4 mm). PMMA implant showed similar equivalent-stress at fixation point (25 MPa) with bon implant (29.2 MPa), however, central stress (100MPa) increased to 200%. Time to reach maximum impact was 1.05 ms (control), 2.1 ms (PMMA) and 0.7 ms (HA). In this module HA did not show material failure. Impact force on PMMA (63% of control value) explains HDPE could not compensate the effect by spongy bone.

CONCLUSIONS: In this study, composite prosthesis using PMMA, HA and HDPE was an lyzed by dynamic finite element modeling.

140. Transcranial Ultrasound Diagnostic Method of Intracranial Hematoma in Childhood

Author: Andrey I. Tsibizov, MD

INTRODUCTION: Intracranial hematoma (ICH) is one of the most dangerous and urgent states in case of a cranio cerebral trauma(CCT). Thus, up to today there has been no effe tive non-invasive method of express diagnosis and urgent neurosurgery. With the help o modern USG-apparatuses, the method of trans-cranial ultrasonography (TUS) has been worked out as well as the tactics of its use in the most effective way. The aim of this wo is to analyze abilities of TUS in express diagnosis of childrens's ICH.

METHODS: The research has been carried out using the sonography apparatus "Aloka S 260" with the sectoral (3,5 MHz) and linear (5 MHz) gages. General characteristics of s ing standart modes are listed in the table 1. When estimating the USG picture, the natu of revealed symptoms (both direct and indirect) was taken into account as well as of changes of the USG picture (both local and diffuse). Direct symptoms included changes of the USG density (echogenicness) of separate parts of the picture. Zones of increased, constant, decreased, low and heterogeneous USG density (hyper-, iso-, hypo-, an- and anisoechogenic zones) were separated. Indirect symptoms were revelated in the from o asymmetries of volume, from and/or position of separate elements of the USG picture ing the research from the left and right side. The method of USG monitoring was used: consequent researches two hours later—during two days (up to 12 researches). Results TUS were confirmed during CT, an operation and/or an autopsy.

RESULTS: Results of 3,970 USG researches of brain of 2455 children from 7 days to 1 years old were studied. It was revelated that 31 children had ICH, in the most cases of traumatic genesis (28 patients).

CONCLUSIONS: 1.Transcranial ultrasonography is the effective screening method of express-diagnosis of children's intracranial hematomas. 2. Considerably more high diagnostic abilities of the transcranial ultrasonography, in comparision with the A-method, allows it to replace the latter in day-to-day children's neuro-traumatology practicle. 3. Tactics of stage-by stage use of the neuro picture in case of children's cranio-cerebral trauma is the optimal.

141. ATV Accidents in the Pediatric Population

Authors: George T. Burson, MD (Little Rock, AR), Bruce Greenberg, MD (Little Rock, AR), Sadaf Bhutta, MD (Little Rock, AR)

INTRODUCTION: All terrain vehicles (ATV) have become a mode of transportation in our state for recreation, work, farming, and hunting. Because of the vast modes of transportation and the laws regulating these vehicles, we are seeing an increasing number of ATV accidents. All ATV accidents that were admitted to our facility between January 1998 to June 2001 will be reviewed.

METHODS: Retrospective review of Emergency Department visits and trauma admission of patients seen at Arkansas Children's Hospital from January 1998 to June 2001. Only patients that were admitted to the hospital were included in this review.

RESULTS: Between January 1998 to June 2001, 115 patients were admitted to Arkansas Children's Hospital for Total ATV related injuries (83 males/32 females). The age ranged from 6 months to 18 years of age. Of the 115 patients, 48 (33 male/15 female) suffered head injuries or spinal cord injuries. Their ages ranged from 3–18 years of age. Forty patients suffered head injuries of that forty, four patients required craniotomies. Eight patients had spinal injuries of that eight, two had spinal stabilizations. Four patients died from their injuries. Outcomes differed. Fourteen had complete recovery, seventeen had long term disabilities and seventeen had what we described as short term disabilities. Of 48 injured patients, less than 25% were wearing helmets. The total cost of inpatient care will also be discussed.

CONCLUSIONS: It is felt that ATVs are very dangerous vehicles. Due to the the ATV size, center of gravity and the severity of injuries incurred by our patients this is especially true in the pediatric population. More strict laws regulating ATVs are needed and the ones that are in place need to be enforced.

142. Recent Experience in the Management of Atlanto-Occipital Dislocation in Children: A Review of Three Cases

Authors: Michael P. Steinmetz, MD (Cleveland, OH), Meg Verrees, MD (Cleveland, OH), Roseanna M. Lechner, MD (Cleveland, OH), James S. Anderson, MD (Cleveland, OH)

INTRODUCTION: Foundation for the management of AOD in children is purely anecdotal. Some authors have demonstrated healing with orthotic immobilization alone, while others insist that this type of injury, because of its instability, necessitates immediate surgical fixation and fusion. We present our experience with the management of AOD in children.

METHODS: A retrospective chart review of cases of atlanto-occipital dislocation in persons less than 16 years of age was performed for the years 1999 through 2000.

RESULTS: Three cases were identified with survival greater than 48 hours. Two were younger than 3 years of age. Both had complete AOD, one was neurologically intact and the other had severe quadraparesis and cranial nerve findings on arrival. The third case was 13 years of age with complete AOD and tetraparalysis on arrival. Case one and two had healing of their AOD with orthotic immobilization alone. Case three underwent occipital-cervical fusion. Case one remained neurologically intact, case two had improvement, and case three remained tetraplegic.

CONCLUSIONS: Infants and toddlers with AOD should undergo halo reduction and immobilization. This age group has the greatest chance for healing without surgery. Older children with AOD and complete neurologic injury are the most unstable and should undergo early occipital-cervical fusion. Those with incomplete AOD and incomplete or no neurologic deficit should undergo orthotic immobilization as management. Older children with complete AOD and incomplete or neurologic injury have potential to heal without surgery. If there is persistent instability after orthotic immobilization, occipital-cervical fusion should be performed. Our patients managed with the aforementioned protocol have maintained occipital cervical stability, and there has been no loss of neurologic function.

143. A Novel Model of Communicating Hydrocephalus and Leptomeningeal Leukemia in Genetically Modified Mice

Authors: Michael D. Taylor, MD (Toronto, Canada), Rebecca A. Gladdy, MD (Toronto, Canada), Christine J. Williams, PhD (Toronto, Canada), James T. Rutka, MD PhD (Toronto, Canada), Cynthia J. Guidos, PhD (Toronto, Canada), Jayne S. Danska, PhD (Toronto, Canada)

INTRODUCTION: We present a novel model of spontaneous communicating hydrocephalus and leptomeningeal leukemia in p53-/-SCID Rag2-/- mice. Spread of systemic leukemia to the CNS in humans occurs almost exclusively in the leptomeninges, not the brain parenchyma. Prophylaxis against leptomeningeal leukemia (craniospinal radiation) has serious side-effects including diminished cognition and secondary neoplasia. Mice mutant for p53 and DNA-PK (SCID mutation) have impaired DNA damage repair and a high incidence of systemic leukemia. RAG genes are involved in cleaving DNA during lymphocyte development.

METHODS: We bred p53-/-RAG-2-/-SCID mice and compared them to control p53-/-SCID mice who are known to develop systemic leukemia. When the leukemia became symptomatic (due to respiratory distress from systemic disease, or hydrocephalus with leptomeningeal disease) the mice were sacrificed by CO2 inhalation and the brain was fixed in formalin. The brains were analyzed by standard histological techniques and immunohistochemistry.

RESULTS: Whereas p53-/-SCID mice die of systemic leukemia, we were suprised that p53-/-RAG-2-/-SCID mice develop a stereotypical syndrome of domed-head, decreased feeding and ataxia. p53-/-RAG-2-/-SCID but not p53-/-SCID littermates showed communicating hydrocephalus secondary to leukemic spread to the leptomeninges. Similar to humans with CNS spread of leukemia, there was leptomeningeal disease without infiltration of the brain parenchyma, highly suggesting that penetration of the blood-CSF barrier by malignant cells is different from the blood-brain barrier. Humans and mice with leptomeningeal leukemia show clustering of leukemic cells in the subarachnoid spaces around veins, suggesting that this may be the route of entry to the CSF. Very few leukemic cells were seen within the ventricular system.

CONCLUSIONS: We present a novel murine model of communicating hydrocephalus and leptomeningeal leukemia. Spread of leukemia to the CSF but not the brain parenchyma in both mice and humans suggests an important difference between the blood-CSF and the blood-brain barrier. The paucity of cells within the ventricular system as well as the clustering of cells around veins in the sub-arachnoid space suggests that leukemic cells may enter the CSF at the level of subarachnoid veins.

144. Dandy Walker Malformation and Tethered Spinal Cord

Authors: Raymond Wang, MD (Los Angeles, CA), Moise Danielpour, MD (Los Angeles, CA), Dan Gruskin, MD (Los Angeles, CA), John M. Graham, Jr., MD (Los Angeles, CA)

INTRODUCTION: While Dandy Walker Malformation can occur as an isolated defect, it is also seen with a variety of multiple congenital anomaly syndromes and various chromosomal anomalies. Other CNS anomalies have also been described in conjunction with DWM, most notably agenesis of the corpus callosum and hydrocephalus. We report three cases of DWM, each with different underlying disorders, occurring in conjunction with occult spinal dysraphism and a tight filum terminale.

METHODS: Three infants with Dandy Walker Malformation who were found to have cutaneous stigmata and/or neurological/orthopeadic findings underwent Diagnostic Magnetic Resonance Imaging of the Lumbosacral spine. Presence of Fatty filum terminale or a conus level below the third lumbar level were diagnostic of a tethered spinal cord.

RESULTS: Three children with Dandy Walker Malformation each occuring with a different underlying disorder were found to occur in association with a tethered spinal cord.

CONCLUSIONS: We hypothesize that children with DWM are more likely to have associated tethered cords as a result of tight filum terminale, and propose that children with DWM should receive sacral MRI to visualize their spinal cords.

145. A Model of Pulsatile CSF Motion in Syrinxes and Archnoid Cysts

Authors: Michael R. Egnor, MD (Stony Brook, NY), Joseph R. Madsen, MD (Boston, MA), Lili Zheng, PhD (Stony Brook, NY), Arthur P. Rosiello, MD (Stony Brook, NY)

INTRODUCTION: Over the past decade, flow sensitive MRI has permitted the measurement of CSF velocity in spinal cord syrinxes and arachnoid cysts. Bradley and other investigators have described the "rebound sign", in which the CSF pulsations in the cyst lead the pulsations in the subarachnoid space by a quarter cycle. The "rebound" refers to the reversal of the CSF motion in the cyst at mid systole. The physical basis for the rebound sign has remained obscure.

METHODS: We have developed a model of CSF pulsations based on the physics of harmonic motion. Equations governing simple harmonic motion and alternating current are analogous, and we have used PSpice to simulate pulsatile CSF motion. Because subarachnoid CSF pulsations are normally in phase with the vascular pulsations, we simulate the subarachnoid space around the cyst as a resonant RLC circuit. The cyst represents a capacitive diverticulum off the subarachnoid space, and is modeled as a capacitor in parallel with the subarachnoid circuit.

RESULTS: The current through the capacitor leads the current in the main circuit by 90 degrees, and at midsystole the direction of the current changes to oppose that of the main circuit. The current waveforms closely resemble the rebound sign.

CONCLUSIONS: The simulation suggests that CSF pulsations can be described by the physics of harmonic motion. These dynamics suggest a mechanism by which syrinxes and arachnoid cysts may enlarge; the cyclic rebound progressively compresses and attenuates the tissue surrounding the cyst. An understanding of the pulsatile dynamics may lead to new approaches to treatment of arachnoid cysts and syringomyelia.

146. The Relationship Between Raised Intracranial Pressure And Visual Loss In Syndromic Craniosynostosis

Authors: Richard D. Hayward, FRCS (London, England), Ken Nischal, FRCS (London, England), Sonya Gonsalez, MD (London, England), Dominic Thompson, FRCS

INTRODUCTION: Raised ICP that is otherwise clinically occult can cause severe visual loss in children with syndromic craniosynostosis. In order to make its early detection and treatment as effective as possible requires knowledge of its incidence, its natural history, its form (height of baseline and plateaux) and whether or not other factors combine with it to produce harm.

METHODS: We have analysed the clinical and radiological details and ICP records of 60 children with syndromic craniosynostosis investigated in our unit. We have combined this information with a review of the details of ICP studies published from other craniofacial centres.

RESULTS: Raised ICP (>15mmHg)was recorded in 46/60 (77%) of our children. The incidence in the published literature ranges from 34–75%. The majority of children studied have been <2 years of age with baseline pressures around 20 mmHg. Plateaux pressures (when recorded) have ranged from 37–48 mmHg. and were associated with significant drops in cerebral perfusion pressures. Accompanying problems included anomalous venous drainage and a high incidence of upper airway obstruction.

CONCLUSIONS: Amalgamation of our own data with that from other series allows us to conclude that: 1. Raised ICP occurs frequently in syndromic craniosynostosis. 2. It is a dynamic process that requires co-factors to cause harm. 3. It is rare for it to be responsible for damage to vision at <1 year and >7 years. 4. Damage to vision is multi-factorial and due to the interplay between raised ICP, venous hypertension, impaired cerebral (and optic nerve) perfusion and the hypoxia that accompanies upper airway obstruction.

147. Withdrawn

148. Encephalocele As a Late Complication of Cranial Vault Reconstruction in a Patient With Crouzon's Syndrome

Authors: Jeffrey Caplan, MD (Jackson, MS), Andrew D. Parent, MD (Jackson, MS), Michael Angel, MD (Jackson, MS)

INTRODUCTION: Encephalocele is a rare late complication of craniosynostosis repair. An undiagnosed nick to the dura may be the etiology of this complication. However, the encephalocele usually presents within a few months to years after repair.

METHODS: This case report describes a patient with Crouzon's Disease who underwent a craniosynostosis repair as an infant and presented with a late complication 22 years later in the form of an encephalocele. The patient had a thorough physical exam, 2D and 3D CT Scans as a preoperative workup. Late surgical intervention included repair of the encephalocele, cranialization of the frontal sinus with bone graft and Lefort III osteomies for mid face advancement.

RESULTS: The patient benefited from a two-team simultaneous approach between neurosurgery and plastic surgery. The patient also benefited from an aggressive one-stage repair of all her defects and deformities.

CONCLUSIONS: An encephaloceles is a complex defect that results in a multisystemic malformation. Often, an encephalocele requires direct repair or duroplasty and autologous caverial or rib bone graft to reduce the herniated dura and to repair the bony defect. Other midfacial, ocular, or nasal defects might be present and should be repaired simultaneously and as early as possible to allow for the best potential results.

149. Case Report: Chronic Headaches as Sequelae of Rigid Fixation for Craniosynostosis

Authors: Joel Beck, MD (Jackson, MS), Andrew D. Parent, MD (Jackson, MS), Michael Angel, MD (Jackson, MS)

INTRODUCTION: Rigid fixation has been used over the last 20 years for the long-lasting correction of traumatic and congenital craniofacial defects. It has been noted that the use of plates and screws can result in migration through the skull, ending up along the inner cortex and imbedding in the dura. In addition, the safe use of titanium plates in the pediatric population is controversial.

METHODS: We report the case of an 8-year-old boy who presented to our clinic with a chronic headache after rigid craniofacial fixation using titanium plates 7 years before. Our service noted him to have right coronal craniosynostosis that had been repaired elsewhere at 4 months of age. After moving here in 1998, the patient complained of right sided headaches that increased in intensity and frequency over the ensuing months. The pediatric specialists who worked up the headaches could find no etiology. The physical exam noted flattening of the right supraorbital rim and 4 mm of dystonia. CT scan revealed several hardware fragments and osseous asymmetry but normal underlying brain. At surgery, plates were seen buried in the nose; additionally, screws were seen perforating the dura. The hardware was removed, and no dural repair was necessary. In addition to right orbital reconstruction, his forehead was reconstructed. Absorbable plates and hydroxyapatite were used to complete the reconstruction.

RESULTS: Postoperatively, the patient's facial symmetry has improved, and he no longer experiences the extreme preoperative headaches.

CONCLUSIONS: At the meeting presentation, we will illustrate the foregoing history and observations.

150. Continuous Intrathecal Baclofen Therapy for Spasticity: Improvement in The Quality of Life

Authors: Elbert A. White, IV, MD (Jackson, MS), Amanda L. Ellis, RN (Jackson, MS), V.V. Vedanarayanan, MD (Jackson, MS), John A. Lancon, MD (Jackson, MS)

INTRODUCTION: Continuous intrathecal baclofen therapy (ITB) has become a common treatment for spasticity in children. We present our initial results with ITB with respect to improvements in quality of life for the child and caregivers.

METHODS: Over a 2-year period, 60 children with spasticity were referred for evaluation by a dedicated spasticity management team. Following the initial evaluation and testing, a baclofen pump was implanted in 40 children. All children were followed at 3 month intervals following pump placement.

RESULTS: Our results with respect to improvement in Ashworth score, spasm score, feeding, weight gain, dressing, positioning, mobility, hygiene, skin care, pain, overall level of comfort, ease of transportation, and impact on family life are presented.

CONCLUSIONS: Continuous ITB has profound effects on the quality of life of children suffering with spasticity and their caregivers.

151. Visual Loss Following Successful Ventriculoperitoneal Shunt Revision

Authors: Michael D. Medlock, MD (Boston, MA), Amanda Yaun, MD (Washington, DC)

INTRODUCTION: Visual loss complicating surgery may be as devastating as it is difficult to predict.

METHODS: An 8 year old child had intermittent abdominal pain and headaches. CT scan showed small ventricles. Fundoscopic exam under anesthesia by a pediatric ophthalmologist showed no papilledema. Intracranial pressure monitoring showed intermittent pressure waves up to 40 mm H20. Two days following a ventriculoperitoneal shunt revision she lost vision over less than 24 hours. Alertness and behavior were at pre-malfunction baseline. Pupils were 4 mm and non-reactive to light with a right gaze preference and no response to visual threat. Dexamethasone 20 mg was given intravenously. Shunt tap showed clear fluid with a pressure of 10 cm H2O. MR scan showed i) the catheter placed near the mesial occipital cortex, ii) The ventricles were slightly larger, iii) no evidence of occipital lobe edema or infarction. The catheter tip was surgically repositioned and proximal and distal pressures were normal. She remained severely visually impaired 18 months following surgery.

RESULTS: Visual loss following surgery may be related to direct trauma, hypotension, large blood loss, retinal artery occlusion, retinal vein occlusion, occipital lobe ischemia, vasopressors, anemia or toxic substances. Visual loss due to increased intracranial pressure is well known. Only 3 previous articles have reported visual loss following rapid reduction of longstanding increased intracranial pressure. Small optic nerves appear to be more susceptible. Steroids and optic nerve sheath fenestration are of unproven benefit.

CONCLUSIONS: Visual loss has been reported as late as 10 days following surgery. Delay in visual loss following surgery to reduce ICP has not been previously reported. Other instances of delayed neurological deterioration following surgery include: ataxia and mutism following midline posterior fossa surgery, athetosis and chorea following hypothermic circulatory arrest in children with congenital heart disease, and Sydenhamls chorea. Is there a common thread to these problems?

152. Endoscopic-Guided Fenestration of Symptomatic Cavum Septum Pellucidum and Cavum Vergae Cysts

Authors: John D. Morenski, MD (Columbia, MO), David F. Jimenez, MD, F.A.C.S. (Columbia, MO)

INTRODUCTION: Cavum Septum Pellucidum (CSP) and Cavum Vergae (CV) form normally in-utero and typically regressed by birth. While the majority of persistent CSP and CV remain occult, expanded cavum, designated CSP CV cysts, can become clinically symptomatic. We have successfully treated six patients who presented with large and symptomatic cavi cysts with a minimally invasive endoscopic-guided laser fenestration to the ventricular system.

METHODS: We retrospectively review six patients, ages ranging from 2 to 65 years, with four patients under 18 years of age, who suffered from symptomatic CSP and CV cysts. Symptoms included nausea, vomiting, increase in head circumference in an infant, diplopia, decreased concentration, and chronic headaches associated with coughing, sneezing, or bending. All patients received a single lateral frontal burr hole with endoscopic-guided YAG laser fenestration of the septal leaves.

RESULTS: All patients were discharged by their second post-operative day. They experienced no complications, specifically no hemorrhages, infections, seizures, neurologic injuries, or deaths. All patients achieved complete resolution of their symptoms including stabilization of the head circumference in an infant.

CONCLUSIONS: CSP and CV cysts can cause a number of symptoms and signs which include chronic and postural headaches, postural loss of consciousness, psychological changes, nausea, sporadic vertigo, papilledema and hydrocephalus as a result of elevated intracranial pressure and mass effect. We successfully treated six patients with symptomatic CSP and CV cysts with endoscopic-guided fenestration. The procedure provides a safe, direct, and effective method of treating symptomatic CSP cysts.

153. Pulsatile Dynamics of Intracranial Pressure and Response to Shunting: A Computational Mechanical Model Using Simulink®

Authors: Joseph R. Madsen, MD (Boston, MA), Michael Egnor, MD (SUNY Stony Brook, NY)

INTRODUCTION: Maintenance of consistent blood flow with minimal dissipative energy loss to tissues requires that the closed intracranial space function as a harmonic oscillator which functions optimally at a specific resonant frequency. Egnor, Rosiello, and Zheng presented an alternating current circuit analog model which emphasized this effect, and provided a direct explanation of observed phenomena on cardiac gated MRI studies, including the quarter-cycle phase advance seen in CSF movement in arachnoid cysts.

METHODS: We now demonstrate an alternative computational model, using linked mechanical oscillators rather than electrical signal elements, which runs on the popular Simulink platform. The block diagram approach of this modeling program allows addition and study of putative control elements, which may be critical to CSF and intracranial dynamics. Variables are specified as vector quantities with a linear time-independent (LTI) state-space approach.

RESULTS: Specific results include: 1) a feedback from intracranial pressure to cardiac rate and contractility shows that the Cushing response is a reflex which maintains resonant energy transfer; 2) CSF diversion shunts can improve or worsen the resonant dynamics, depending on the physical parameters of the shunt.

CONCLUSIONS: Pulsatile dynamics of CSF and intracranial contents may thus be important considerations in the pathophysiology of hydrocephalus and the design of therapeutic strategies.

154. Initial Experience with a Programmable Valve (Strata) for the Surgical Treatment of Hydrocephalus

Authors: Mark G. Hamilton, MDCM, FRCSC (Calgary, Alberta)

INTRODUCTION: The surgical management of hydrocephalus with ventriculoperitoneal shunts remains a difficult endeavor frequently associated with problems of over drainage (e.g. subdural effusions or hematomas) and under drainage (e.g. ineffective treatment). These problems may significantly complicate treatment outcome, and can result in additional surgical procedures. The Strata valve was introduced in Canada as an adjunct for the treatment of hydrocephalus in July 2000. The Strata valve allows for 5 separate permutations of the Delta valve (Delta 0.5, 1.0, 1.5, 2.0, 2.5) with transcutaneous adjustments to valve resistance easily made after implantation. The Delta valve has "antisiphon" capabilities.

METHODS: A prospective database was maintained from onset of utilization of the Strata valve. Demographic and surgical data was obtained from this source.

RESULTS: A total of 25 patients have had a Strata valve inserted either for the initial treatment of hydrocephalus or at the time of a shunt revision. There were 3 pediatric patients and 22 adult patients. The indications for utilization of the Strata valve were not standardized. The aim of this preliminary assessment was to evaluate ease of use, reliability, and safety. The Strata valve was used in 5 patients with shunt-induced subdural hematomas. Adjustments to valve resistance were made in 23 patients (92%), predominately to decrease outflow resistance. All valve adjustments were accomplished without difficulty. One patient had her shunt removed after a third ventriculostomy. No valve malfunction or safety issues were encountered.

CONCLUSIONS: The Strata valve offers the capability for noninvasive change in shunt system outflow resistance. This initial experience suggests that this valve could be used with ease and safety during management of hydrocephalus. A prospective, randomized clinical trial to assess efficacy is being developed.

155. Schwannoma of The Jugular Foramen: Case Report

Authors: Elbert A. White, IV, MD (Jackson, MS), Melanie L. Petro, MD (Jackson, MS), Amanda L. Ellis, RN (Jackson, MS), John A. Lancon, MD (Jackson, MS)

INTRODUCTION: Schwannomas of the jugular foramen are rare; only a few pediatric cases have been reported.

METHODS: We describe a 16-year-old male with hearing loss and tinnitus of several months duration. The general physical examination was significant for the absence of cutaneous stigmata. The neurological examination was significant for diminished hearing in the right ear, asymmetry of the blink reflex, and leftward deviation of the uvula with palatal elevation. Imaging studies demonstrated a well-defined, homogeneously enhancing mass extending from an enlarged jugular foramen across the caudal cerebellopontine angle cistern into the lateral cerebellum.

RESULTS: A retrosigmoid approach with subtotal mastoidectomy allowed complete excision of the mass. Histopathologic analysis including immunostains was consistent with schwannoma.

CONCLUSIONS: The microsurgical anatomy of the jugular foramen and the literature relating to jugular schwannomas in children are reviewed. The correct diagnosis may not always be considered prior to surgical exposure of the tumor owing to the rarity of jugular schwannoma and its tendency to present with symptoms suggestive of a cerebellopontine angle mass. A thorough understanding of the microsurgical anatomy of the jugular foramen facilitates resection of this interesting lesion.

156. Mesenchymal Chondrosarcoma of the Sphenoid Ridge: Case Report

Authors: John A. Lancon, MD (Jackson, MS), Amanda L. Ellis, RN (Jackson, MS)

INTRODUCTION: Mesenchymal chondrosarcoma involving the skull base is extremely uncommon.

METHODS: We present the case of an 8-year-old male with septo-optic dysplasia who presented with lethargy and a left hemiparesis. Imaging studies showed a large, heterogeneous mass with multiple small cysts originating from the right sphenoid ridge and filling the sylvian fissure.

RESULTS: A gross total resection of the mass including adjacent dura and parenchyma was performed. The middle cerebral artery was encased and thrombosed by the tumor and was resected as part of the specimen. Histopathology including immunostains was consistent with a mesenchymal chondrosarcoma. The preoperative lethargy and hemiparesis resolved.

CONCLUSIONS: The literature pertaining to mesenchymal chondrosarcoma with intracranial involvement is reviewed and recommendations for multimodality treatment of this rare lesion are outlined.

157. Hypothalamic-opticochiasmatic Gliomas Mimicking Craniopharyngiomas

Authors: Erica F. Bisson, MD (Burlington, VT), Sami Khoshyomn, MD (Burlington, VT), Todd A. Maugans, MD (Burlington, VT)

INTRODUCTION: In children the differential diagnosis of suprasellar masses commonly includes craniopharyngiomas and hypothalamic-opticochiasmatic gliomas. Preoperative differentiation of these two tumors is an important neuroimaging goal, as the nature of surgical management is predicated by this speculation. In this report we review the cases of three patients with ages ranging from 3–14 years with suprasellar tumors initially thought to be craniopharyngiomas based on neuroimaging.

METHODS: Three cases and a relevent literature review are presented.

RESULTS: All patients presented with headache, nausea and vomiting. Neurological exam in one patient revealed a left-sided 6th cranial nerve palsy; the neurological exam was normal in two patients. Preoperative brain computed tomography (CT), magnetic resonance imaging (MRI), endocrinological and ophthamological studies were performed in all patients. CT revealed various degrees of hydrocephalus in all cases and calcifications in 2/3. On MRI, all lesions were large suprasellar masses which exhibited a predominantly cystic appearance with heterogeneous enhancement of the solid portion of the tumor, characteristic of craniopharyngiomas. Intraoperatively all tumors appeared to involve the hypothalamus and the chiasm to varying degrees. The histopathological exam in all tumors was consistent with pilocytic astrocytoma.

CONCLUSIONS: Hypothalamic-opticochiasmatic gliomas mimicking craniopharyngiomas represent a diagnostic challenge to the pediatric neurosurgeon. Although an accurate leading pathologic diagnosis can frequently be made with preoperative neuroimaging, the neurosurgeon must be prepared for discovery of another tumor type and have plans to proceed accordingly.

158. Spinal Deformity After Surgery For Paediatric Spinal Tumours

Authors: Simon A. Cudlip, FRCS (London, England), Kim Phipps, (London, England), Dominic N. Thompson, FRCS (London, England), William J. Harkness, FRCS (London, England), Richard D. Hayward, FRCS (London, England)

INTRODUCTION: Surgery for spinal tumours presents particular hazards, especially in the paediatric population. These tumours can be associated with significant neurological deficits, large surgical exposures and often require postoperative adjuvant therapy, all of which can have a profound effect on the developing skeleton.

METHODS: Data was obtained from the prospectively gathered extensive clinical information of the departmental neuro-oncology patient database.

RESULTS: Over a 19 year period (1980–1999) 107 patients were identified with spinal tumours who had been followed up for 2 or more years. Mean age at diagnosis was 6.7. Overall 31% patients that had a posterior exposure of the tumour developed a progressive spinal deformity (28/91), for intramedullary tumours this rose to 45% (19/42). Features identified that correlated significantly with development of a spinal deformity included presence of a preoperative deformity, relationship of tumour to spinal cord, number of levels exposed, whether postoperative radiotherapy was given, and the degree of neurological deficit after treatment. Age at diagnosis was related to development of a deformity but did not reach significance.

CONCLUSIONS: Despite modern surgical techniques such as en bloc plastic laminotomies, and a heightened awareness of late spinal deformity with widespread use of postoperative orthoses, late spinal deformity remains a serious clinical problem. Features identified in this study associated with a higher risk of late spinal deformity such as preoperative deformity, severity of postoperative neurological deficit, number of laminae operated upon and intramedullary tumour origin may help identify those patients at risk, and lead to earlier intervention in the treatment of this difficult problem.

159. Radiology Pitfalls of Pediatric Ependymoma

Authors: Honeycutt H. John, MD (Memphis, TN), Renatta Osterdock, MD (Memphis, TN), Blonie W. Dudney, (Memphis, TN), Frederick A. Boop, MD (Memphis, TN), Robert A. Sanford, MD (Memphis, TN)

INTRODUCTION: Through this retrospective study, 54 ependymomas treated at a single institution (St.Jude) were evaluated for problems associated with neuroimaging.

METHODS: The authors retrospectively reviewed 54 ependymomas treated at St. Jude Children's Research Hospital from 1979 to 2001 evaluating the problems associated with neuroimaging. A national cooperative ependymoma study will begin in the fall of 2001, in which the principle selection criteria for treatment groups will be based on gross total resection versus subtotal resection.

RESULTS: Problems noted in this series are: 1) Preoperative MR scans revealing a portion of tumor which enhances with contrast, and a portion which does not, and the difficulty recognizing on postoperative imaging of the nonenhancing residual tumor, especially when the contrast enhancing portion was resected. 2) Misleading postoperative T2 images. 3) Errors interpreting enhancing hemostatic agent (surgical and gelfoam)—the 2 mm rule for surgical resection. 4) Preoperative noncontrast enhancing tumor—does tumor enhance postoperatively? Recommendations will be given regarding: 1) Preoperative MR assessment to avoid these surgical pitfalls. 2) Timing of postoperative neuroimaging.

CONCLUSIONS: Hopefully sharing this radiology experience will help avoid errors which will compromise patient care and jeopardize the quality of Children's Oncology Group (COG) protocol.

160. Ventriculoperitoneal Shunts in Patients with Disseminated Brain Tumors

Authors: Karl F. Kothbauer, MD (New York, NY), Dennis R. Buis, MD (New York, NY), George I. Jallo, MD (New York, NY), Linda Velasquez, MS (New York, NY), Fred J. Epstein, MD (New York, NY)

INTRODUCTION: The objective of this report is to assess the impact of ventriculoperitoneal shunting on patients with disseminated brain tumors complicated by communicating hydrocephalus.

METHODS: This is a retrospectively analyzed series. Sixteen patients with disseminated tumors who underwent shunt placement between 1990 and 2001 were identified. Data were obtained from review of office charts, imaging studies, and from phone interviews with family members. The type of tumor, the previous therapy, the type of shunt-related complications, the total number of shunt-related operations, and the time to shunt revision were noted.

RESULTS: Six male and ten female patients (mean age 6.2 years, range 5 months to 14 years) were included. There six high grade gliomas (including diffuse pontine gliomas in 2), four ependymomas, three medulloblastomas, one brainstem ganglioglioma, and two pilocytic astrocytomas. Eight patients (50 %) had no complications and no further surgeries after the initial shunt placement. Four patients (25%) had either infection or wound breakdown, resulting in a total of eight additional operations. Six patients (37.5 %) had episodes of shunt obstruction. This resulted in 16 additional procedures. Two patients had obstruction and infection. Average time from shunt placement to the first revision was 25 days (range 11 days to 4 months).

CONCLUSIONS: The complication rate of shunt placement in this small group of neurooncologic patients with disseminated brain tumors and subsequent hydrocephalus is significant and appears to be higher than the average complications rate in other hydrocephalus series.

161. Delayed Onset of Common Peroneal Nerve Palsy Following Acute Ankle Inversion

Authors: Elbert A. White, IV, MD (Jackson, MS), Melanie L. Petro, MD (Jackson, MS), Amanda L. Ellis, RN (Jackson, MS), V.V. Vedanarayanan, MD (Jackson, MS), John A. Lancon, MD (Jackson, MS)

INTRODUCTION: We report a 12-year-old girl who developed a foot drop 3 days following an acute inversion injury of the left ankle.

METHODS: Examination was consistent with complete loss of motor function of the deep and superficial peroneal nerves with relative preservation of sensory function. Electrophysiological testing was consistent with injury to the common peroneal nerve distal to the takeoff of the biceps femoris branches.

RESULTS: At surgery a wide constricting fascial band was found to compress the distal common peroneal nerve just prior to its entry into the fibular canal. The compressed segment was flattened, pale and nodular to palpation. Intraoperative testing of nerve-to-nerve conduction velocities was used to isolate a 3 centimeter segment of nerve with markedly reduced conduction velocity corresponding to the area of compression. A microsurgical external and internal neurolysis was performed.

CONCLUSIONS: The literature relating to the delayed onset of common peroneal nerve palsy following acute ankle injury is reviewed. The pathophysiologic mechanism of injury is debated but may involve stretch-induced disruption of the vasa nervorum or compression of the nerve at its entry into the fibular canal. The role of surgical intervention in the management of this unusual nerve injury is summarized.

162. Are Infant Traumatic Chronic Subdural Hematomas Really Hematomas or are they Dynamic CSF "Hematohygromas" ?

Authors: Alexander Zouros, MD (Edmonton, Canada), Keith E. Aronyk, MD (Edmonton, Canada), Bhargava Ravi, MD (Edmonton, Canada), Michael Hoskinson, MD

INTRODUCTION: A common finding in infants subjected to violent traumatic forces is bilateral subdural hematoma often explained as chronic subdural hematoma suggesting repeated trauma or rebleeding. We attempted to determine the nature of the fluid in these subdural collections—is it primarily CSF or is it blood breakdown products related to repeated hemorrhage from subdural membranes?

METHODS: Five infants were victims of suspected non-accidental head injury (NAHI) and all had bilateral mixed density subdural collections treated by burr hole evacuation and external subdural drainage. Once subdural drainage was well established and intracranial pressure controlled, radiotracer was injected into the lumbar subarachnoid cistern. The tracer was followed by serial scanning in an attempt to follow the CSF flow from spine to brain to the CSF absorption site. Daily volume and appearance of subdural drainage fluid was recorded. All five cases had MRI studies of the subdural-subarachoid spaces.

RESULTS: In all five cases the radiotracer injected into the lumbar subarachnoid space moved rapidly into the subdural space and out into the subdural catheter system—demonstrating an active communication between the arachnoid envelope and the subdural space. The subdural drainage fluid changed from hemorrhagic (red) fluid to xanthochromic fluid over a 3–5 day period while daily volumes of subdural drainage ranged from 60ml–250ml.

CONCLUSIONS: Many of the subdural fluid collections noted in infants suspected of NAHI are not chronic subdural hematomas but dynamic CSF hematohygromas presumably due to tears of the arachnoid envelope along the superior sagittal sinus in the same way that bridging veins are thought to be torn. These hematohygromas may be misinterpreted as chronic subdural hematomas suggesting rebleeding or repeated trauma. Only one traumatic event is required to produce these hemorrhagic subdural collections.

163. The Prevalence of Pediatric Cervical Spinal Trauma in Newark, New Jersey

Authors: Catherine A. Mazzola, MD (Pittsburgh, PA), Sean Xie, MD (Newark, NJ), Ricky Madhok, MS (Newark, NJ), C. David Hunt, MD (Newark, NJ)

INTRODUCTION: The prevalence of pediatric spinal trauma has been reported to range from 2–5% of all patients with traumatic spinal injury. University Hospital, in Newark, New Jersey is a Level One, five hundred and fifty-five bed, trauma center. In the past twelve years, from June of 1988 through March of 2000, the Department of Neurological Surgery has cared for one thousand three hundred and eight (1,308) patients with spinal trauma. Through a retrospective database review, eighty-four patients with cervical spine trauma, who were eighteen years of age or younger were identified. These patients represented 6.4% of all spinal trauma patients. It was our intentions to identify the mechanism of injury, to determine the level of care given on transport, to note whether patients had spinal precautions maintained, and to determine outcomes for these patients.

METHODS: Chart reviews were accomplished to determine the etiology of the trauma, to analyze hospital course and to determine discharge status and outcomes.

RESULTS: Eighty-two percent (N=69) of mechanism of injury were known; the most common cause of cervical spine injury was associated with motor vehicle accident-passenger/driver. Overall, sixteen (23%) of patients were intubated on admission. Fifty-five percent of patients were transported by ALS teams; however, only eighty-seven percent of those were boarded and collared for transport. Ninety-six percent of all children had some sort of diagnostic study in the emergency room. The days of care ranged from consult only through 143 days.

CONCLUSIONS: Spinal precautions maintained throughout transport to the trauma facility may prevent unnecessary injury to the cervical spine. In most cases, these precautions were observed for the studied patients.

164. Reflections on Shunt Infection

Author: Paul M. Kanev, (Hershey, PA)

INTRODUCTION: The use of endoscopic third ventriculostomy has reduced shunting in selected patients, however the placement and revision of ventriculo-peritioneal (vp) shunt remains a mainstay in the surgical treatment of hydrocephalus. The most challenging complication of shunt surgery remains infection. While the north american infection averages nearly 8% published infection rates for vp shunt infection below 1% have been reported. We have retrospectively reviewed three 1/2 years of shunt operation by a single surgeon to analyze the infection rate.

METHODS: Surgical technique involves limited touch manipulation of the shunt hardware. Rubber-tipped instruments handle the tubing and valve components, and finger contact with skin in minimized. All new shunt are placed frontally, inserting a unitized Delta 1.0 valve systems with Ghajar tripod assistance. New shunts were inserted into the abdomen with trocar technique. Intraoperative antibiotics include nafcillin and gentamycin and the former medication is continued for 24 hours postoperative.

RESULTS: In three 1/2 years, we have completed 390 shunt placement or revision in patients up to 18 years of age. Patient weight exceeded 2kg in all cases. The total number of neurosurgical procedures during this time was 848 cases. There have been four shunt infections. In each case the organism was S. epidermitis. The infection was treated with external venticulostomy drainage and intravenous antibiotics. The new shunt was replaced at a new incision site after 7 days of sterile spinal fluid cultures. The mean follow-up among these patients after shunt insertion is 19 months.

CONCLUSIONS: While third venticulostomy is a highly successful alternative to shunting in the appropriate patient, vp shunting remains the most common operation for hydrocephalus. Infections are linked with seizures, higher future risks of shunt infection and malfunction, and reduced IQ and school performance. Our infection rate during 3 1/2 years has been limited to 1.0%. Uniform surgical technique and limited hardware and skin edge manipulation may be a factor in limiting shunt infection. Our discussion will highlight technical consideration.

NOTES ON POSTER ABSTRACTS

AANS/CNS SECTION
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NEUROLOGICAL SURGERY

30TH ANNUAL MEETING

November 28–December 1
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2001 MEMBERSHIP ROSTER

Rick Abbott, MD
Beth Israel Med. Ctr.
170 E. End Ave./Neuro.
New York, NY 10128-7603

Jafri Malin Bin Abdullah, MD PhD
Hosp. Univ. Sci./Neurosurgery
16150 Kubang Kerian
Kelantan, Malaysia

P. David Adelson, MD FACS
Children's Hosp. of Pittsburgh
3705 Fifth Ave./Neurosurgery
Pittsburgh, PA 15213-2583

Nejat Akalan, MD
Dept. of Neurosurgery
Hacettepe Univ. Sch. of Med.
Ankara 06100

A. Leland Albright, MD
Children's Hosp. Pittsburgh
3705 5th Ave./Neurosurgery
Pittsburgh, PA 15213-2524

Lance Altenau, MD
501 Washington; STE 700
San Diego, CA 92103-2231

A. Loren Amacher, MD
Dept. of Neurosurgery
Geisinger Clinic
Danville, PA 17822-1405

Luis V. Amador, MD
1440 Veteran Ave.; STE 336
Los Angeles, CA 90024-4832

Ahmed S. Ammar, MD PhD
P. O. Box 3014
El Salam City
Cairo, Egypt 11757

Jim D. Anderson, MD
PO Box 658
San Carlos, CA 94070-0658

Brian T. Andrews, MD
STE 521
2100 Webster St.
San Francisco, CA 94115-2373

Thomas J. Arkins, MD
Connecticut Neurosurgery PC
330 Orchard St. STE 316
New Haven, CT 06511-4417

Patricia A. Aronin, MD
1215 Red River Street/STE 201
Austin, TX 78701-0000

Elaine J. Arpin, MD
S.W. Florida Neuro. Assoc.
413 Del Prado Blvd.; STE 102
Cape Coral, FL 33990-5703

Wilson T. Asfora, MD
800 Watercress Cir.
Sioux Falls, SD 57108-2816

Saleh S. A. Baeesa, MD
King Abdulaziz University Med Ctr.
P.O.Box 80215
Jeddah, Saudi Arabia 21499

Walter L. Bailey, MD
Doctors' Professional Bldg.
280 N. Smith Ave.; STE 234
St. Paul, MN 55102-2475

Gene A. Balis, MD
STE 340
3000 E. Fletcher Ave.
Tampa, FL 33613-4645

Steven J. Barrer, MD
2510 Maryland/Willowood STE 185
Willow Grove, PA 19090-0000

Henry M. Bartkowski, MD PhD
Children's Hosp. Rm 6301
1 Perkins Square
Akron, OH 44308-1062

James E. Baumgartner, MD
3418 Georgetown St.
Houston, TX 77005-2910

Robert M. Beatty, MD
8919 Parallel Pkwy.; STE 455
Kansas City, KS 66112-1655

William O. Bell, MD
Carolina Neuro. Assoc. PA
2810 Maplewood Ave.
Winston Salem, NC 27103-4138

Edward C. Benzel, MD
Cleveland Clinic Fdtn.
9500 Euclid Ave.; Desk S80
Cleveland, OH 44195-0001

Mitchel S. Berger, MD
UCSF/Neurosurgery
505 Parnassus; Box 0112
San Francisco, CA 94122-2722

Jose A. Bermudez, MD
102 Thomas Rd.; STE 107
West Monroe, LA 71291-7365

Karin S. Bierbrauer, MD
Temple Univ.
3401 N. Broad St.; STE 658
Philadelphia, PA 19140-5103

Peter McL. Black, MD PhD
Children's Hosp.
300 Longwood Ave.
Boston, MA 02115-5724

Jeffrey P. Blount, MD
1600 7th Ave., S./ACC 400
Birmingham, AL 35233-0000

John Scott Boggs, MD
1820 Barrs St.; STE 104
Jacksonville, FL 32204-4742

Frederick A. Boop, MD
Semmes-Murphey Clinic
220 S. Claybrook; STE 600
Memphis, TN 38104-3562

William R. Boydston, MD
STE 540
5455 Meridian Mark Rd.
Atlanta, GA 30342-1640

Bruce C. Bressler, MD
720 S. Van Buren STE 302
Green Bay, WI 54301-3538

Douglas L. Brockmeyer, MD
Primary Children's Med. Ctr.
100 N. Medical Dr.; STE 2400
Salt Lake City, UT 84113-1103

Jeffrey Alan Brown, MD
Harper Profession Office Bldg./
Dept. of Neuros.
4160 John R/STE 930
Detroit, MI 48201-0000

Derek A. Bruce, MD
Neurosurgeons for Children
7777 Forest Ln.; B308
Dallas, TX 75230-2505

William A. Buchheit, MD
6014 Cricket Rd.
Flourtown, PA 19031-1203

Michael James Burke, MD FACS FA
Institute of South Texas/Neurosurgery
3643 S. Staples
Corpus Christi, TX 78411-2456

Leslie D. Cahan, MD
Neurosurgery
1505 N. Edgemont St.; Rm.4141
Los Angeles, CA 90027-5209

Alexa Irene Canady, MD
6064 Forest Green
Pensacola, FL 32505-0000

Carolyn Marie Carey, MD
880 Sixth St. S.
St. Petersburg, FL 33701-0000

Peter W. Carmel, MD
New Jersey Med. Sch./Neuro.
90 Bergen St.; STE 7300
Newark, NJ 07103-2425

Benjamin Carson, MD
Johns Hopkins Hosp.
600 N. Wolfe St.; Harvey 811
Baltimore, MD 21287-8811

Michael J. Chaparro, MD
Neuro. Inst. of Palm Beach
5507 S. Congress Ave. STE 150
Atlantis, FL 33462-1139

2001 MEMBERSHIP ROSTER

Paul H. Chapman, MD
Massachusetts Gen. Hosp.
55 Fruit St.; GRB502
Boston, MA 02114-2621

William R. Cheek, MD
3009 Robinhood
Houston, TX 77005-0000

Maurice Choux, MD
Hopital Des Enfants
De La Timone; Cedex 5
Marseilles, 13385

Samuel F. Ciricillo, Jr. MD
5238 Fair Oaks Blvd.
Carmichael, CA 95608-5766

David Douglas Cochrane, MD
Childerens & Womens Health Ctr.
B2 West 4500 Oak St.
Vancouver, BC V6H-3N1

Philip Harry Cogen, MD PhD
Children's National Med. Ctr.
111 Michigan Ave.; N.W./Neuro.
Washington, DC 20010-2916

Alan R. Cohen, MD
Case Western Reserve Univ.
11100 Euclid Ave./Neuro.
Cleveland, OH 44106-1736

John J. Collins, MD
1767 Sunnypark
Redlands, CA 92374-5578

Shlomi Constantini, MD
Dana Children Hosp.
6 Weizman St./Ped. Neurosurg.
Tel Aviv, Israel 64239

Richard A. Coulon, Jr. MD
Childrens Hospital/
Dept of Neurosurgery
200 Henry Clay Ave
New Orleans, LA 70118-0000

Jeffrey W. Cozzens, MD
Northwestern/Div. of Neurosurgery
2650 Ridge Ave. STE 4215
Evanston, IL 60201-1718

Kerry R. Crone, MD
Children's Hosp. Med. Ctr.
3333 Burnet Ave./Neurosurgery
Cincinnati, OH 45229-3026

T. Forcht Dagi, MD
STE 475
2500 Northwinds Pkwy.
Alpharetta, GA 30004-2243

Robin I. Davidson, MD
Univ. Massachusetts Med. Ctr.
55 Lake Ave.; N./Neuro.
Worcester, MA 01604-1135

Richard A. Day, MD
2835 Fort Missoula Rd STE 02
Missoula, MT 59804-7423

Concezio Di Rocco, MD
Univ. Cattolica/Neurochirurgia
Largo Gemelli 8
Rome, Italy 00168

Mark S. Dias, MD
Penn State Milton S Hersey Med Ctr
850 University Dr.
Hershey, PA 17033-0000

Michael Dorsen, MD
STE 210
3615 N.W. Samaritan Dr.
Corvallis, OR 97330-3783

James R. Doty, MD
1102 Pine St
Menlo Park, CA 94025-3407

James M. Drake, MD
Hosp. for Sick Children
555 University Ave.; #1504-D
Toronto, ON M5G-1X8

Ann-Christine Duhaime, MD
Child. Hosp. of Philadelphia
34th & Civic Ctr. Blvd./Neuro.
Philadelphia, PA 19104-0000

Charles Cecil Duncan, MD
PO Box 208082
333 Cedar St. TMP 416
New Haven, CT 06520-8082

John A. Duncan, III MD
2 Dudley St. STE 530
Providence, RI 02905-3236

Mary E. Dunn, MD
280 N. Smith Ave.; STE 234
St. Paul, MN 55102-2420

Michael S.B. Edwards, MD
2800 L St.; STE 340
Sacramento, CA 95816-5616

Michael R. Egnor, MD
NY Spine & Brain Surgery PC
Dept. of Neurosurgery/
HSC T12-080 SUNY
Stony Brook, NY 11794-8122

Stephanie L. Einhaus, MD
4425 Barfield Road
Memphis, TN 38117-2411

Howard M. Eisenberg, MD
University of Maryland/Neurosurgery
22 S. Greene St.; STE S12D
Baltimore, MD 21201-1544

Ibrahim Muftah El Nihum, MD
Scott & White Hosp.
2401 S. 31st St.
Temple, TX 76508-0001

Richard G. Ellenbogen, MD
5616 N.E. 55th
Seattle, WA 98105-2835

Seyed M. Emadian, MD PhD
8339 Steeplechase Drive
Palm Beach Gardens, FL 33418-0000

Fred J. Epstein, MD
Beth Israel Med. Ctr.; N. Div.
170 E. End Ave.
New York, NY 10128-7603

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

Walter J. Faillace, MD
Univ. of Florida-Jacksonville
653 W. 8th St./Neurosurgery
Jacksonville, FL 32209-6511

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

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

Edwin G. Fischer, MD
110 Francis St.; STE 3B
Boston, MA 02215-5501

Ann Marie Flannery, MD
Med. Coll. of Georgia/
Children's Medical Center
1120 15th Street
Augusta, GA 30912-4010

Eldon L. Foltz, MD
Dept. of Neurosurgery UCI Med. Ctr.
101 City Dr. - Bldg 3, Rte 81, Rm 313
Orange, CA 92868-3201

Paul C. Francel, MD PhD
Univ. of Oklahoma HSC/Neurosurgery
711 Stanton L. Young Blvd. STE 206
Oklahoma City, OK 73104-5021

Kathleen B. French, MD
3020 Hamaker Ct.; STE B104
Fairfax, VA 22031-2220

Arno H. Fried, MD
Hackensack Univ. Med. Ctr.
30 Prospect Ave./WFAN Peds Ctr
Hackensack, NJ 07601

David M. Frim, MD
Univ. of Chicago MC/Neuro.
5841 S. Maryland Ave.; MC-4066
Chicago, IL 60637-1463

Herbert E. Fuchs, MD PhD
Duke Med. Ctr./Neurosurgery
Box 3272
Durham, NC 27715-3272

Joseph H. Galicich, MD
PO Box 276
Alpine, NJ 07620-0276

2001 MEMBERSHIP ROSTER

Sarah J. Gaskill, MD
4499 Medical Dr.; STE 397
San Antonio, TX 78229-3713

Rosemaria Gennuso, MD
1661 Soquel Dr., STE F
Santa Cruz, CA 95065-1709

Richard E. George, Jr. MD
3506 21st St.;STE 400
Lubbock, TX 79410-1200

Timothy M. George, MD
Duke Univ. Med. Ctr.
Box 3272/Div. of Neurosurgery
Durham, NC 27710-0001

P. Langham Gleason, MD
531 Harkle STE D
Santa Fe, NM 87505-4753

John C. Godersky, MD
2841 De Barr Rd.; STE 34
Anchorage, AK 99508-2956

James T. Goodrich, MD PhD
Dept. of Neuro./Montefiore
111 E. 210th St.
Bronx, NY 10467-2401

Liliana C. Goumnerova, MD FRCSC
Children's Hosp.; Bader 3
300 Longwood Ave.
Boston, MA 02115-5724

Paul A. Grabb, MD
Children's Hosp.
1600 7th Ave.; S.; ACC 400
Birmingham, AL 35233-1711

Clarence S. Greene, Jr. MD
2865 Atlantic Ave. STE 202
Long Beach, CA 90806-1740

Laurance J. Guido, MD
30 Sutton Pl.; STE 15A
New York, NY 10022-2365

Nalin Gupta, MD PhD
Univ. of California San Francisco/
Neurosurgery
505 Parnassus Ave. Rm. M779
Box 0112
San Francisco, CA 94143-0112

Francisco A. Gutierrez, MD
201 E. Huron; STE 9-160
Chicago, IL 60611-2980

Jens Haase, MD
Moegelbjergvej 50
Vodskov, 9310

Yoon Sun Hahn, MD
Univ. of IL at Chicago Coll. of Med.
912 S. Wood St./Ped. Neurosurg.
Chicago, IL 60612-7325

Stephen J. Haines, MD
MUSC/Dept. of Neurosurgery
171 Ashley Ave.
Charleston, SC 29425-0001

Sten E. Hakanson, MD
Lilla Ojelsbo S-590 98
Edsbruk, Sweden

Mark G. Hamilton, MD
Alberta Children's Hosp.
1820 Richmond Rd.; S.W.
Calgary, AB T2T-5C7

Lonnie L. Hammargren, MD
3196 S. Maryland Pkwy STE 06
Las Vegas, NV 89109-2312

Mary Kathryn Hammock, MD
8620 Rolling Rd.
Manassas, VA 20110-3828

Michael H. Handler, MD
STE 605 Tammen Hall
1010 E. 19th Ave.
Denver, CO 80218-1034

William C. Hanigan, MD PhD
719 N. William Kumpf Blvd STE 00
Peoria, IL 61605-2513

Michael D. Heafner, MD
Carolina Neurosurgery & Spine
1010 Edgehill Rd.; N.
Charlotte, NC 28207-1885

Michael A. Healy, MD
Neurosurgical Network Inc.
2222 Cherry Street, STE M200
Toledo, OH 43608-2604

Dan S. Heffez, MD
2515 N. Clark St.; STE 800
Chicago, IL 60614-2720

Leslie C. Hellbusch, MD
8005 Farnam Drive STE 305
Omaha, NE 68114-4441

David C. Hemmy, MD
20611 Watertown Rd.; STE J
Waukesha, WI 53186-1871

Robert W. Hendee, Jr. MD
4710 Lookout Mountain Cv.
Austin, TX 78731-3654

Tenoch Herrada-Pineda, MD
Ave. 527 No. 281
Unidad San Juan de Aragon
Mexico City, D.F., 07920

Thomas J. Holbrook, Jr. MD
114 Gateway Corporate Blvd. STE 420
Columbia, SC 29203-9785

Robert D. Hollenberg, MD
McMaster Univ./Surgery Dept.
1200 Main St.; W.; RM 4E8
Hamilton, ON L8N-3Z5

Gregory W. Hornig, MD
4501 W. 87 Terrace
Shawnee Mission, KS 66207-1919

Roger Hudgins, MD
5455 Meridan Mark Rd., STE 540
Atlanta, GA 30342-1640

Stephen L. Huhn, MD
Stanford Univ.
300 Pasteur Dr. R203
Palo Alto, CA 94304-2203

Robin P. Humphreys, MD
Hosp. for Sick Children
555 University Ave.; #1504
Toronto, ON M5G-1X8

Mark R. Iantosca, MD
100 Retreat Ave STE 705
Hartford, CT 06106-2528

Bermans J. Iskandar, MD
Univ. of Wisconsin/Neurosurg.
600 Highland Ave.; H4/334
Madison, WI 53792-0000

George I. Jallo, MD
205 Commercial Avenue/STE 37
Palisades Park, NJ 07650-0000

Hector E. James, MD
7930 Frost St.; STE 103
San Diego, CA 92123-2738

John A. Jane, MD PhD
Univ. of Virginia/Neurosurgery
Hosp. Box 212
Charlottesville, VA 22908-0000

David F. Jimenez, MD
Univ. of Missouri Hosp. & Clinic
One Hospital Dr.; N521
Columbia, MO 65201-5276

Dennis L. Johnson, MD
408 Elm Ave.
Hershey, PA 17033-1751

John K. Johnson, MD
20 Medical Ridge Dr.
Greenville, SC 29605-5605

Martin Johnson, MD
31870 S.W. Country View Ln.
Wilsonville, OR 97070-7476

Mary M. Johnson, MD
3223 Chatham Rd.
Atlanta, GA 30305-1101

Robert F. C. Jones, MD
21 Norfolk St.
Paddington, Australia 2021

2001 MEMBERSHIP ROSTER

Allen S. Joseph, MD
7777 Hennessy Blvd.. STE 10000
Baton Rouge, LA 70808-4300

John E. Kalsbeck, MD
Riley Children's Hosp.
702 Barnhill Dr.
Indianapolis, IN 46202-5200

Paul M. Kanev, MD
Hershey Med. Ctr./Neurosurgery
850 University Dr.
Hershey, PA 17033-0850

Samuel S. Kasoff, MD
11 Sycamore Ln.
White Plains, NY 10605-5001

Bruce A. Kaufman, MD
Childrens Hosp. of
Wisconsin/Neurosurgery
9000 W. Wisconsin PO Box 1997
Milwaukee, WI 53201-1997

Robert F. Keating, MD
1521 35th St.; N.W.
Washington, DC 20007-2729

David L. Kelly, Jr. MD
Wake Forest Sch. of Med.
Medical Center Blvd./Neuro.
Winston-Salem, NC 27157-1029

John R. W. Kestle, MD
Ped. Neurosurgery
100 N. Medical Dr.; STE 2400
Salt Lake City, UT 84113-1103

David M. Klein, MD
690 Fearrington Post
Pittsboro, NC 27312-8507

Laurence I. Kleiner, MD
5304 Indian Grave Rd.; STE A
Roanoke, VA 24014-6608

David S. Knierim, MD
GED 4
9300 Valley Childrens Pl.
Madera, CA 93638-8761

Edward J. Kosnik, MD
Chatham Village Prof. Bldg.
931 Chatham Ln.
Columbus, OH 43221-2417

Karl F. Kothbauer, MD
Beth Israel Med. Ctr./Neurosurgery
170 E. End Ave.
New York, NY 10128-7603

Mark D. Krieger, MD
Mount Sinai MC/Neurosurgery
1 Gustave L. Levy Pl. Box 1136
New York, NY 10029-6500

Cornelius H. Lam, MD
Code 96 Mayo D-429 Mayo
420 Delaware St. S.E./Neuros.
Minneapolis, MN 55455-0374

John P. Laurent, MD
Texas Childrens Hosp.
6621 Fannin St.; MC 3-3435
Houston, TX 77030-2303

Edward R. Laws, Jr. MD
Univ. of Va/Dept Neurosurgery
Health Sciences Ctr.; Box 800212
Charlottesville, VA 22908-0212

Mark Robert Lee, MD
Med. Coll. of Georgia
1120 15th St./Neuros. BIW-3088
Augusta, GA 30912-0004

Michael Lee Levy, MD
Childrens Hosp.
1300 N. Vermont Ave. STE 906
Los Angeles, CA 90027-6005

Veetai Li, MD
Dept. of Neurosurgery
219 Bryant St.
Buffalo, NY 14222-2006

Kenneth I. Lipow, MD
267 Grant St.
Bridgeport, CT 06610-2805

John D. Loeser, MD
Univ. of Washington
Box 356470/Neurosurgery
Seattle, WA 98195

Morris D. Loffman, MD
PO Box 17210
Encino, CA 91416-7210

Rafael Longo-Cordero, MD
Univ. Gardens
Calle Rochester 911
San Juan, PR 00927-4812

Ralph C. Loomis, MD
7 McDowell St.
Asheville, NC 28801-4103

Kenneth M. Louis, MD
3000 E. Fletcher Ave.. STE 340
Tampa, FL 33613-4656

Mark G. Luciano, MD PhD
Cleveland Clinic Foundation
9500 Euclid Ave.; S-80
Cleveland, OH 44195-0001

Thomas G. Luerssen, MD
Riley Hosp. for Children
One Children's Sq.; STE 1730
Indianapolis, IN 46202-5200

Joseph R. Madsen, MD
Children's Hosp./Neurosurgery
300 Longwood Ave.; Room 312
Boston, MA 02115-5724

Gail A. Magid, MD
241 Fourth Avenue
Santa Cruz, CA 95062-3815

Gary Magram, MD
9 La Porta Court
Metuchen, NJ 08840-0000

Kim Herbert Manwaring, MD
Phoenix Children's Hosp.
909 E. Brill Street
Phoenix, AZ 85006-0000

Timothy B. Mapstone, MD
The Emory Clinic Inc
1365-B Clifton Rd; NE; STE 6400
Atlanta, GA 30322-1013

Arthur E. Marlin, MD
Methodist Plaza
4499 Medical Dr.; STE 397
San Antonio, TX 78229-3713

Todd A. Maugans, MD
Univ. of Vermont/Neurosurgery
Fletcher 5 / 111 Colchester Ave
Burlington, VT 05401-0000

John R. Mawk, MD
411 Laurel St., STE 2350
Des Moines, IA 50314-3005

James P. McAllister, II PhD
Wayne State Univ. Schl. of Medicine/
Dept. of Neurosurgery
University Health Center, STE 6E
Detroit, MI 48201-2153

Jack E. McCallum, MD
800 8th Ave.; STE 220
Fort Worth, TX 76104-2619

J. Gordon McComb, MD
1300 N. Vermont Ave. STE 906
Los Angeles, CA 90027-6005

C. Scott Scott McLanahan, MD
Carolina Neuro. & Spine Assoc.
1010 Edgehill Rd.; N.
Charlotte, NC 28207-1885

Robert L. McLaurin, MD
2412 Ingleside Ave.; Apt. 5C
Cincinnati, OH 45206-2185

David Gordon McLone, MD PhD
Children's Mem. Hosp.
2300 Children's Plaza; Box 28
Chicago, IL 60614-3318

John Mealey, Jr. MD
9315 Spring Forest Dr.
Indianapolis, IN 46260-1269

2001 MEMBERSHIP ROSTER

Michael Dean Medlock, MD
Mass Gen. Hosp./
Dept. of Neurosurgery
55 Fruit St. WACC-021
Boston, MA 02114-2621

Arnold H. Menezes, MD
Univ. of Iowa Hosp. & Clinics
200 Hawkins Dr.
Iowa City, IA 52242-1009

Glenn A. Meyer, MD
Med. Coll. of Wisconsin/Neuro
9200 W. Wisconsin Ave.
Milwaukee, WI 53226-3522

W. Jost Michelsen, MD
Box 6978
Portsmouth, NH 03801-0000

Thomas H. Milhorat, MD
State Univ. of NY/HSC-Brooklyn
Box 1189; 450 Clarkson Ave.
Brooklyn, NY 11203-2098

Clinton F. Miller, MD
Coastal New Hampshire Neuro.
330 Borthwick Ave. STE 108
Portsmouth, NH 03801-7110

John I. Miller, MD FACS
544 E. 86th St.; STE 6W
New York, NY 10028-7536

Richard H. Moiel, MD
3656 Ella Lee Ln.
Houston, TX 77027-4105

Jose L. Montes, MD
The Montreal Children's Hosp.
2300 Tupper St.; Room C811
Montreal, PQ H3H-1P3

German Montoya, MD
Orlando Neurosurgical Associates
1801 Cook Avenue
Orlando, FL 32806-2913

Mahmood Moradi, MD
920 Frostwood, Ste. 625
Houston, TX 77024-0000

Thomas M. Moriarty, MD PhD
Kosiar Children's Hospital
210 E. Gray St.; STE 1102
Louisville, KY 40202-3907

Michon Morita, MD
1319 Punahou St.; STE 999
Honolulu, HI 96826-1032

William J. Morris, MD
1112 6th Ave. STE 302
Tacoma, WA 98405-4048

Glenn Morrison, MD
Miami Children's Hosp.
3200 S.W. 60 Ct.; STE 301
Miami, FL 33155-4071

S. David Moss, MD
Phoenix Children's Hosp.
909 E. Brill St.
Phoenix, AZ 85006-2513

Kamel F. Muakkassa, MD
157 W. Cedar St., STE 203
Akron, OH 44307-2564

Michael S. Muhlbauer, MD
930 Madison Ave.; STE 600
Memphis, TN 38103-3401

Michael G. Muhonen, MD
455 S. Main St.
Orange, CA 92868-3835

Karin M. Muraszko, MD
Univ. of Michigan; Box 0338
2128 Taubman Hlth. Ctr.
Ann Arbor, MI 48109-0338

Awni F. Musharbash, MD
PO Box 910262
Amman, Jordan 11191

Cheryl A. Muszynski, MD
Ped. Neurosurgery PO Box 1997
MS 405
9000 W. Wisconsin Ave
Milwaukee, WI 53201-1997

S. Terence Myles, MD
1820 Richmond Rd.; S.W.
Calgary, AB T2T-5C7

John S. Myseros, MD
Children's Hospital Med. Ctr.
3333 Burnet Ave.; Ped. Neuros.
Cincinnati, OH 45229-3026

Joseph M. Nadell, MD
Children's Hosp.
200 Henry Clay Ave.
New Orleans, LA 70118-5720

Mahmoud G. Nagib, MD
305 Piper Bldg.; 800 E. 28th St.
Minneapolis, MN 55407-3799

Mark Stephen O'Brien, MD
1900 Century Blvd.; STE 4
Atlanta, GA 30345-3307

W. Jerry Oakes, MD
Childrens Hosp. of Alabama
1600 7th Ave.; S.; STE 400
Birmingham, AL 35233-1711

Miguel A. Pagan, PA-C
19136 Cypress View Dr.
Fort Myers, FL 33912-4825

Larry Keith Page, MD
13845 S.W. 73rd Ct.
Miami, FL 33158-1213

Dachling Pang, MD
Kaiser Permanete Hosp.
2025 Morse Ave.
Sacramento, CA 95825-2115

Andrew D. Parent, MD
Univ. of Mississippi MC
2500 N. State St.
Jackson, MS 39216-4500

Tae Sung Park, MD
St. Louis Children's Hosp.
1 Children's Pl./Neurosurgery
St. Louis, MO 63110-1002

Michael David Partington, MD
Neurosurgery Assoc.
280 N. Smith Ave.; STE 234
St. Paul, MN 55102-0000

Jogi V. Pattisapu, MD
22 W. Lake Beauty Dr., STE 204
Orlando, FL 32806-2037

Jerry O. Penix, MD
928 Holladay Point
Virginia Beach, VA 23451

Joseph A. Petronio, MD
St. Paul Neurosurgical
280 N. Smith Ste. 234
St. Paul, MN 55102-0000

Joseph H. Piatt, Jr. MD
St. Christopher's Hosp. for
Children/Sect. of Neurosurgery
Erie Avenue at Front Street
Philadelphia, PA 19134-1095

Prem Kumar Pillay, MD
Asian Brain-Spine-Nerve Ctr.
3 Mt. Elizabeth; #15-03
Singapore, Singapore 228510

Hal Watson Pittman, MD
44 E. Palm Ln.
Phoenix, AZ 85004-1529

Thomas Pittman, MD
Univ. of Kentucky/Chandler MC
800 Rose St./Neurosurgery MS105-A
Lexington, KY 40536-0000

Ian F. Pollack, MD
Children's Hosp. of Pittsburgh
3705 Fifth Ave./Neurosurgery
Pittsburgh, PA 15213-2524

Harold D. Portnoy, MD
Oakland Neurological Clinic P.C.
44555 Woodward Ave. STE 506
Pontiac, MI 48341-2982

Antonio R. Prats, MD
PO Box 440757
Miami, FL 33144-0757

2001 MEMBERSHIP ROSTER

Mark R. Proctor, MD
300 Longwood Ave.; Bader 3
Boston, MA 02115-5724

Corey Raffel, MD PhD
Mayo Clinic/Neurosurgery
200 First St.; S.W.
Rochester, MN 55905-0001

John Ragheb, MD
Lois Pope Life Ctr.
1095 N.W. 14 Ter. STE 04-6
Miami, FL 33136-2104

Donald H. Reigel, MD
5178 Polo Field Dr.
Gibsonia, PA 15044

Harold Louis Rekate, MD
Barrow Neurosurg. Assoc. Ltd.
2910 N. 3rd Ave.
Phoenix, AZ 85013-4434

Arden F. Reynolds, Jr. MD
Quincy Med. Group
1025 Maine St.
Quincy, IL 62301-4038

Theodore S. Roberts, MD
Childrens Hospital Med. Ctr.
CH-50; 4820 Sand Point Way NE
Seattle, WA 98105-0000

Shenandoah Robinson, MD
Pediatric Neurosurgery
11100 Euclid Ave.
Cleveland, OH 44106-1736

Walker L. Robinson, MD
602 University Avenue
Urbana, IL 61801-2594

Luis A. Rodriguez, MD
1150 N. 35th Ave.; STE 300
Hollywood, FL 33021-5424

Bruce R. Rosenblum, MD
Riverview Med. Ctr.
160 Aye. at The Commons
Shrewsbury, NJ 07702-4802

Alan Rosenthal, MD
Long Island Neuro. Assoc.
410 Lakeville Rd.
New Hyde Park, NY 11042-1101

Allen S. Rothman, MD FACS
175 Memorial Highway
New Rochelle, NY 10801-5640

John R. Ruge, MD
630 S. Oak St.
Hinsdale, IL 60521-4634

James T. Rutka, MD PhD FRC
Hospital for Sick Children
555 University Ave./Neuro-Ste 1504
Toronto, ON M5G-1X8

Petr O. Ruzicka, MD
741 Northfield Ave.; Ste 208
West Orange, NJ 07052-1104

Robert A. Sanford, MD
Semmes-Murphey Clinic
930 Madison Ave.; STE 600
Memphis, TN 38103-3421

Osamu Sato, MD
1-5-40; Tamagawa Gakuen
Machida
Tokyo, Japan 194 0041

Guy M. Sava, MD
501 Holly Ln., STE 50
Mankato, MN 56001-6800

Timothy B. Scarff, MD
33 S.W. Upper Riverdale Rd., STE 25
Riverdale, GA 30274-2626

Steven J. Schiff, MD
Krasnow Inst.
George Mason Univ.; MS 2A1
Fairfax, VA 22030-4444

Steven J. Schneider, MD
Long Island Neuro. Assoc.
410 Lakeville Rd.
New Hyde Park, NY 11042-1101

Luis Schut, MD
Childrens Hosp. Philadelphia
34th and Civic Center Blvd.
Philadelphia, PA 19104

R. Michael Scott, MD
The Childrens Hosp.
300 Longwood Ave. Bader 319
Boston, MA 02115-5724

Edward L. Seljeskog, MD
2805 Fifth St., STE 110
Rapid City, SD 57701-7306

Wan Tew Seow, MD
Dept of Neuro/
National Neuroscience Institute
11 Jalan Tan Tock Seng
Singapore, Singapore

Ronald F. Shallat, MD
33 Evergreen Drive
Orinda, CA 94563-0000

Kenneth N. Shapiro, MD
Neurosurgeons for Children
1935 Motor St.
Dallas, TX 75235-7701

John Shillito, MD
1109 Fearrington Post
6 Caswell Sq.
Pittsboro, NC 27312-5014

Howard J. Silberstein, MD
1445 Portland Ave., STE 304
Rochester, NY 14621-3008

James C. Simmons, MD
190 Grove Park Rd.
Memphis, TN 38117-0000

Gary Robert Simonds, MD
PO Box 14
237 Sunbury Rd
Riverside, PA 17868-0014

Frederick H. Sklar, MD
1935 Motor St.
Dallas, TX 75235-7701

Harold P. Smith, MD
300 20th Ave.; N.; STE 506
Nashville, TN 37203-5608

Lenwood P. Smith, Jr. MD
Palmetto Neurosurgery & Spine
3 Medical Park STE 310
Columbia, SC 29203-6873

Mark M. Souweidane, MD
New York Hosp./Star Pav.
520 E. 70th St. Room 651
New York, NY 10021-9800

Phillip G. St. Louis, MD
Florida Med. Plaza; Suite 540N
2501 N. Orange Ave.
Orlando, FL 32804-4603

Sherman Charles Stein, MD
310 Spruce St.
Philadelphia, PA 19106-4201

Paul Steinbok, MD
B.C. Children's Hosp.
4480 Oak St.; Room A325
Vancouver, BC V6H-3V4

Bruce B. Storrs, MD
Univ. of New Mexico/Neurosurg.
2211 Lomas NE ACC-2
Albuquerque, NM 87131-5341

Douglas L. Stringer, MD
2011 Harrison Ave.
Panama City, FL 32405-4545

Merle Preston Stringer, MD
2011 N. Harrison Ave.
Panama City, FL 32405-4545

Michael H. Sukoff, MD
17602 E. 17th St.; STE 102-118
Tustin, CA 92780-0000

Peter P. Sun, MD
Childrens Hosp.
Oakland/Neurosurgery
744 52nd St.
Oakland, CA 94609-1810

2001 MEMBERSHIP ROSTER

Anthony F. Susen, MD
193 Old Glebe Point Rd.
Burgess, VA 22432-2006

Leslie N. Sutton, MD
Child. Hosp. of Philadelphia
34th & Civic Center Blvd.
Philadelphia, PA 19104-0000

Dale M. Swift, MD
1935 Motor St. - 3rd Fl.
Dallas, TX 75235-7701

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

Tadanori Tomita, MD
Children's Mem. Hosp./Neuros.
2300 Children's Plaza; Box 28
Chicago, IL 60614-3363

Eric R. Trumble, MD
22 W. Lake Beauty Dr. STE 204
Orlando, FL 32806-2033

Gerald F. Tuite, Jr. MD
880 Sixth St. South STE 490
St. Petersburg, FL 33701-4825

Noel Tulipan, MD
8533 McCrory Ln.
Nashville, TN 37221-5905

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

David D. Udehn, MD
4350 Seventh St., Unit E
Moline, IL 61265-6870

Ronald H. Uscinski, MD
Mid-Atlantic brain and Spine Institutes
3301 Woodburn Rd.; STE 209
Annandale, VA 22003-1229

Michael Vassilyadi, MD
Childrens Hosp. East Ontario/
Div. of Neuro.
401 Smyth Rd.
Ottawa, ON K1H-8L1

Joan L. Venes, MD
1831 North Bend Dr.
Sacramento, CA 95835-1218

Enrique C. Ventureyra, MD
401 Smyth Rd.
Ottawa, ON K1H-8L1

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

Steven L. Wald, MD
97 Grove Lane
Shelburne, VT 05482-0000

John B. Waldman, MD
Albany Med. Coll.
Div. of Neurosurgery/MC-61-NE
Albany, NY 12208-0000

Marion L. Walker, MD
Primary Children's Med. Ctr.
100 N. Medical Dr./
Ped. Neuro. Ste 2400
Salt Lake City, UT 84113-1103

John Wilson Walsh, MD
No Address

John D. Ward, MD
Virginia Commonwealth Univ.
Box 980631
Richmond, VA 23298-0631

Daryl E. Warder, MD PhD
Wainwright Bldg /Suite 230
229 West Bute Street
Norfolk, VA 23510-0000

Benjamin C. Warf, MD
PO Box 903
Mbale, Uganda

Martin H. Weiss, MD
USC Med. Ctr.; Box 786
1200 N. State St.; Room 5046
Los Angeles, CA 90033-1029

Jean K. Wickersham, MD
3030 Children's Way; STE 402
San Diego, CA 92123-4228

Philip J. A. Willman, MD
1415 3rd St.; STE 102
Corpus Christi, TX 78404-2107

Ronald J. Wilson, MD
901 S. Mopac Expy.; Bldg. V, STE 210
Austin, TX 78746-5776

Joel W. Winer, MD
York Neurosurgical Assoc.; PC
2319 S. George St.
York, PA 17403-5009

Jeffrey A. Winfield, MD PhD
1000 E. Genesee St. STE 602
Syracuse, NY 13210-0000

Ken R. Winston, MD
Box B330
1056 E. 19th Ave
Denver, CO 80218-1007

Jeffrey H. Wisoff, MD
NYU Med. Ctr./Ped. Neurosurg.
317 East 34th Street/#1002
New York, NY 10016-6402

Daniel Won, MD
Pediatric Neurosurgical Associates
301 Vanderbilt WaySTE 305
San Bernardino, CA 92408-3520

Meredith V. Woodward, MD
Valley Children's Hospital
9300 Valley Children's Place
Madera, CA 93638-8761

Shokei Yamada, MD
Loma Linda Univ. Sch. of Med.
11234 Anderson St; Rm 2526A/Neuro.
Loma Linda, CA 92354-0000

Karol Zakalik, MD
William Beaumont Hosp.
3535 W. 13 Mile Rd.; STE 504
Royal Oak, MI 48073-6710

Ahmad Zakeri, MD
4235 Secor Rd.
Toledo, OH 43623-4231

Edward J. Zampella, MD
PO Box 808
10 Parrott Mill Rd
Chatham, NJ 07928-2744

Luis Manuel Zavala, MD
555 Mowry Avenue/STE A-B
Fremont, CA 94536-4101

John G. Zovickian, MD
3000 Colby St.; STE 101
Berkeley, CA 94705-2058

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