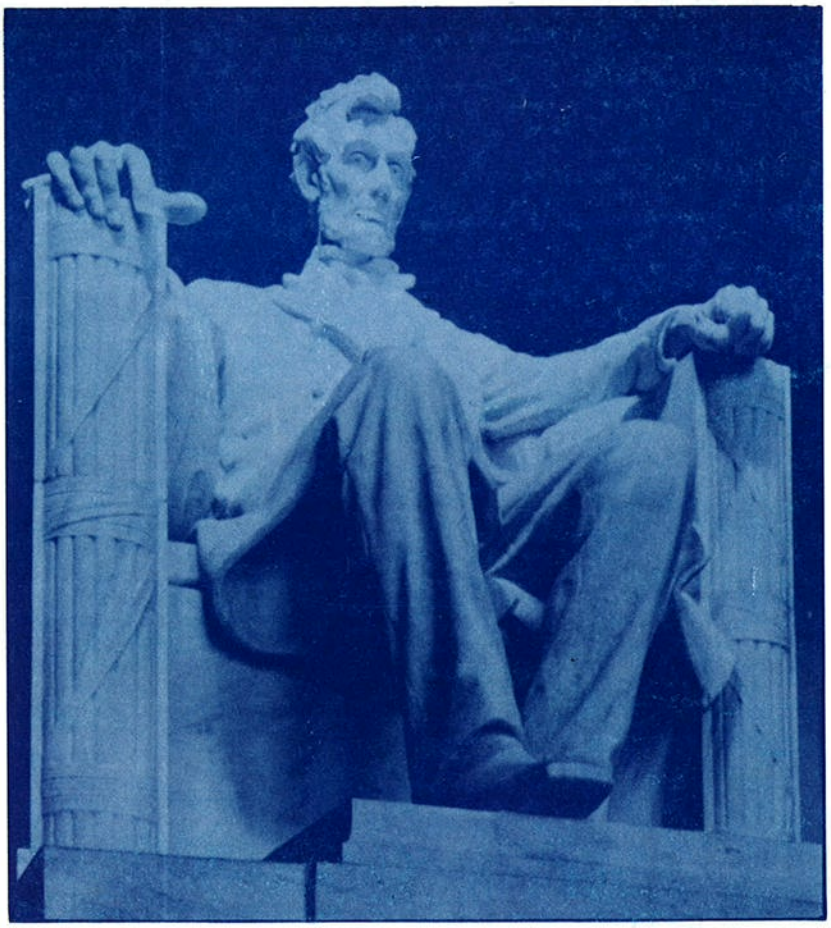
Section on Pediatric Neurological Surgeons
of the
American Association of Neurological Surgeons

18th Winter Meeting Program

November 28 — December 1, 1989
Washington, D.C.



Section on Pediatric Neurological Surgery of the American Association of Neurological Surgeons

18th Annual Meeting

Willard Inter-Continental Hotel
Washington, D.C.
November 28--December 1, 1989

This program has been approved by the Joint Committee on Education of the American Association of Neurological Surgeons and Congress of Neurological Surgeons for a maximum of 15 hours of Category 1 credit toward the Continuing Education Award in Neurosurgery

ram Summary

Paolo Raimondi Lecturers

E. Bruce Hendrick--1978
Paul C. Bucy--1979
Floyd Gilles--1980
(Panel Discussion)--1981
(Panel Discussion)--1982
Derek Harwood-Nash--1983
Anthony E. Gallo, Jr--1984
Frank Nulsen--1985
William F. Meacham--1986
Dale Johnson--1987
Joseph Volpe--1988

Schulman Award

Kim Manwaring--1983
Neonatal Post-hemorrhagic Ventriculomegaly:
Management with Pulsed Lumbar Cisternostomy

Arno Fried--1984
A Laboratory Model of Shunt Dependent
Hydrocephalus

Anne Christine Duhaime--1985
The Shaken Baby Syndrome

Robert E. Breeze--1986
CSF Formation in Acute Ventriculities

Marc R. Del Bigio--1987
Shunt-induced Reversal of Periventricular
Pathology in Experimental Hydrocephalus

Scott Falci--1988
Rear Seatlap belts.
Are They Really 'Safe' for Children?

Pediatric Section Chairmen

Robert L. McLaurin--1972-73
M. Peter Sayers--1973-74
Frank Anderson--1974-75
Kenneth Shulman--1975-76
E. Bruce Hendrick--1976-77
Frank Nulsen--1977-78
Luis Schut--1978-79
Fred Epstein--1979-81
Joan L. Venes--1981-83
Harold J. Hoffman--1983-85
William R. Cheek--1985-87
David G. McLone--1987-89
Donald H. Reigel--1989-

nual Meeting Sites

Dallas	1981
San Francisco	1982
Toronto	1983
Salt Lake City	1984
Houston	1985
Pittsburgh	1986
Chicago	1987
Scottsdale	1988
Washington	1989

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rgeons gratefully recognizes the support
ne 1989 Pediatric Annual Meeting.

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to visit the exhibit area frequently during

Program of the Pediatric Section 18th Winter Meeting

American Association of Neurological Surgeons

TUESDAY, NOVEMBER 28, 1989

6:00 p.m. - 8:00 p.m.
Registration Desk - Foyer

6:00 p.m. - 8:30 p.m.
Reception - Crystal Room

7:00 p.m.
Exhibits Set Up - Buchanan Room

WEDNESDAY, NOVEMBER 29, 1989

7:00 a.m. - 8:00 a.m.
Registration Desk - Foyer

7:00 a.m. - 8:00 a.m.
Continental Breakfast - Exhibits Area

8:00 a.m. - 8:10 a.m.
Welcoming Remarks - David C. McCullough, M.D., Annual Meeting Chairman and Edward R. Laws, M.D., Chairman, Department of Neurosurgery, George Washington University

* Indicates Resident Paper

ON I - Ballroom

Moderators:

D.

onormalities in Association with
phy and Caudal Regression
/. Bell and I. Thomas, Winston

nomalies Associated with
of the Anorectal Complex: A
port", K. Crone, A. Arand, W. Ball
Cincinnati, OH

d Mermaid: Cloacal Extrophy and
ocystocele", A. Cohen and M.
on, MA

of the Incidence and Clinical
the Association Between Anorectal
and Spinal Dysraphic States", B.
osnik, Columbus, OH

epair of Experimental Dysraphism:
or the Treatment of
cele", D. Heffez, J. Aryanpur, J.
. Hutchins, Baltimore, MD

9:30 a.m. - 10:00 a.m.
COFFEE BREAK

10:30 a.m. - 12:15 p.m.
SCIENTIFIC SESSION II - Ballroom

SPINE AND CRANIOVERTEBRAL JUNCTION -
Moderators:
William Cheek, M.D.
Edward Kosnick, M.D.

*6. "Tethered Cord As a Cause of Scoliosis in Children With A Myelomeningocele", J. Herman and D. McLone, Chicago, IL

*7. "Neurogenic Dysphagia Resulting From Chiari Malformations", I. Pollack, D. Pang and S. Kocoshis, Pittsburgh, PA

8. "Anatomical Progression of the Chiari II Malformation", J. Ruge, B. Storrs, J. Masciopinto and D. McLone, Chicago, IL

*9. "Alanto-Axial Instability in Children", M. Muhonen and A. Menezes, Iowa City, IA

10. "Cervical Spine Instability Following Suboccipital Decompression and Cervical Laminectomy For Arnold-Chiari Syndrome", A. Canady, D. Aronson and R. Kahn, Detroit, MI

*11. "A Technique to Decompress and Fuse C1-C2 for Spinal Cord Compression and Alanto-Axial Instability", M. Levy and G. McComb, Los Angeles, CA

vertebral Disc Calcification (JIDC):
d Management", M. Dias and D.
h, PA

agnum Decompression in
c Children", B. Carson, O. Hurko,
and J. Aryanpur, Baltimore, MD

sentation

e Room

ON III - Ballroom

Moderators:
M.D.
M.D.

of Cortical Morphology by
toneal Shunts in Experimental
ocephalus", L. Wright, P. Hale, S.
cAllister, II, Philadelphia, PA

e Syndrome: Etiology and
. Uselman and E. Kosnik, Columbus,

ation of Intraparenchymal Pressure
tricular Pressure in Slit Ventricle
W. Welch, C. Nussbaum and S.
chester, NY

17. "Shunted Aqueduct Hydrocephalus: Control of Overdrainage", E. Foltz, Orange, CA

*18. "Medical Management of Slit Ventricle Syndrome", W. Obana, N. Raskin, P. Cogen and M. Edwards, San Francisco, CA

19. "External Ventricular Drainage: A Clue to CSF Shunt Function", J. Drake, C. St. Rose and M. da Silva, Toronto, ONT

2:30 p.m. - 3:00 p.m.
COFFEE BREAK

3:00 p.m. - 4:15 p.m.
SCIENTIFIC SESSION IV - Ballroom

HYDROCEPHALUS AND CYSTS: - Moderators:
Alexa Canady, M.D.
Jerry Oakes, M.D.

*20. "Management of Persistent Ventriculomegaly Due to Altered Brain Compliance", E. Altschuler, D. Pang and E. Stephanian, Pittsburgh, PA

21. "The Spectrum of the Syndrome of the Isolated Fourth Ventricle in the Child with Hydrocephalus Secondary to Prematurity and Intracranial-Intraventricular Hemorrhage", H. James, San Diego, CA

22. "MRI Analysis of Shunt Function", E. Frank, M. Buonocore, L. Hein, Sacramento, CA

ppler Ultrasonography for the
unt Malfunction", W. Chadduck,
J. Blankenship, Little Rock, AR

achnoid Cysts: Correlation of
ement with CT and MRI Scan
rent and O. Al-Mefty, Jackson, MS

ER 30, 1989

- Exhibits Area

N V - Ballroom

BASIC SCIENCE,
- Moderators:

theroid Infection Versus
- A Study of Cerebrospinal Fluid
Camarata and S. Haines,
N

rospinal Fluid Shunt Infection in
hiff and J. Oakes, Philadelphia, PA

*27. "Dandy-Walker Syndrome: Experience with Thirty-One Cases", R. Osenbach and A. Menezes, Iowa City, IA

28. "Neonatal Piglet Hippocampal Protein Synthesis Deficit During Reperfusion Following Global Cerebral Ischemia", J. Gidday and T. Park, Charlottesville, VA

*29. "Cerebellar Evoked Potentials Recorded from the Rat", R. Hurlbert and C. Tator, Toronto, ONT

30. "Cortical Localization in the Young Child with Epilepsy", G. Morrison, M. Duchowny, T. Resnick and L. Alvarez, Miami, FL

31. "Cranial Remolding After a Wide Midline Strip Craniectomy in Sagittal Craniosynostosis", Y. Hahn, D. McLone, M. Radkowski, Chicago, IL

32. "Bloodless Dissection in Pediatric Craniotomies and Craniofacial Surgeries", K. Manwaring and S. Beals, Phoenix, AZ

10:00 a.m. - 10:30 a.m.
COFFEE BREAK

10:30 a.m. - 12:15 p.m.
SCIENTIFIC SESSION VI - Ballroom

TRAUMA AND INTRACRANIAL HEMORRHAGE - Moderators:
Mark O'Brien, M.D.
Richard Coulon, M.D.

njury Without Radiographic
CIWORA) in Children", R.
. Menezes, Iowa City, IA

Flow and Glucose Metabolism in
rain Edema", L. Sutton, D.
eenberg, S. Dante, Philadelphia,

Minor Head Injury in Children", Y.
Lone, Chicago, IL

ole for Immediate Operative
All Severely Head-Injured
Duma and D. Johnson,

ernal Drainage in the Treatment of
tomas of Infancy", S. Gaskill, J.
n, Durham, NC

perience with Lumbar Drainage in
c Head Injury", H. Baldwin and H.
x, AZ

of ECMO Requiring Neurosurgical
. Oppenheimer, J. Vogt and G.
ngeles, CA

AIMONDI MEMORIAL LECTURE -
M.D. Professor of Surgery, George
ity, Director, Trauma Service,
Washington, D.C.

FREE AFTERNOON

6:30 p.m.
RECEPTION - Pre Function Area

7:30 p.m.
BANQUET - Ballroom

FRIDAY,DECEMBER 1, 1989

7:00 a.m. - 8:00 a.m.
Continental Breakfast - Foyer

8:00 a.m. - 10:15 a.m.
SCIENTIFIC SESSION VII - Ballroom

VASCULAR DISORDERS AND DORSAL RHIZOTOMY -
Moderators:
Parker Mickle, M.D.
Harold Rekate, M.D.

*40. "Serial Ultrasonographic Evaluation of Neonatal Vein of Galen Malformations to Assess the Efficacy of Interventional Neuroradiologic Procedures", S. Ciricillo, M. Edwards, K. Schmidt and N. Silverman, San Francisco, CA

41. "Stereotactic Resection of Pediatric Vascular Malformations", M. Partington, D. Davis and P. Kelly, Rochester, MN

42. "Use of Gait Analysis in Patient Selection for Selective Dorsal Rhizotomy", L. Cahan, J. Adams. J. Perry, and L. Beeler, Orange, CA

Evaluation and Treatment of
uhaime, P. Mickle and M. Mahla,

l Rhizotomy - Some Technical
aines and M. Moret, Minneapolis,

untered in Treating Spasticity", R.
k, NY

Subluxation Following Selective
y in Cerebral Palsy", C. Shaffrey,
Shaffrey and L. Phillips,
/A

ow-up on Results of Selective
ny for the Relief of Spasticity in
l Children", R. Tippets, M. Walker,
Ploeger, Salt Lake City, UT

gic Evidence for Afferent Fibers in
Nerve Roots", M. Shaffrey, L.
ffrey and T. Park, Charlottesville,

ON VIII - Ballroom

BRAIN TUMORS - Moderators:
Edward Laws, M.D.
Donald Reigel, M.D.

*49. "The Postoperative Drawings of Harvey Cushing: The Pediatric Brain Tumors", E. Rossitch, Jr., M. Moore and P. McL. Black, Boston, MA

50. "Fourth Ventricle Astrocytomas in Childhood", T. Tomita, D. McLone and M. Yasue, Chicago, IL

*51. "Choroid Plexus Tumors: Trends in Diagnosis and Management", C. Dickman, H. Rekate, S. Coons and P. Johnson, Phoenix, AZ

52. "Infratentorial Ependymomas in Childhood: Prognostic Factors and Treatment", G. Nazar, H. Hoffman, L. Becker and D. Jenkins, Toronto, ONT

53. "Cavernous Angiomas in Children", M. Scott, Boston, MA

12:00 p.m. - 1:00 p.m.
LUNCHEON - Pierce Room

1:00 p.m. - 2:30 p.m.
SCIENTIFIC SESSION IX - Ballroom

BRAIN TUMORS - Moderators:
Dennis Johnson, M.D.
Peter Carmel, M.D.

*54. "Pediatric Pituitary Tumors", S. Haddad, A. Menezes and J. VanGilder, Iowa City, IA

Chiasmal/Hypothalamic Gliomas
Childhood with Chemotherapy
nary Experience with
d Regimens", J. Petronio, M.
los and V. Levin, San Francisco,

nd Pediatric Brain Tumors", K.
idel, V. Johnson and W. Hall,

as a Prognostic Factor in
s", D. Schofield, J. Geyer and M.
VA

d Extraneural Metastases From
Tumors: An Analysis", B.
erger and P. Kanev, Seattle, WA

s to Locally Release Carboplatin
Growth of Walker 256
', A. Olivi, M. Ewend, M. Pinn, D.
em, Baltimore, MD

N X - Ballroom

erators:
D.

*60. "Growth Hormone Failure Following Radiation Therapy of Primary Brain Tumors", P. Kanev, M. Berger, J. Lefebvre and R. Mauseth, Seattle, WA

61. "The Search for the PNET Gene", C. Raffel, Los Angeles, CA

*62. "Growth Factor Receptors on Pediatric Brain Tumors", W. Hall, M. Merrill and R. Youle, Pittsburgh, PA

63. O-6-Alkylguanine-DNA-Alkyltransferase in Human Medulloblastoma: Relationship With Chloroethylnitrosourea Resistance", M. Berger and F. Ali-Osman, Seattle, WA

64. "Robotic and Computer Assisted Stereotactic Resection of Deep Tumours in Children", J. Drake, M. Joy, A. Goldenberg and D. Kreindler, Toronto, ONT

1. SPINAL CORD ABNORMALITIES IN ASSOCIATION WITH CLOACAL EXTROPHY AND CAUDAL REGRESSION SYNDROMES

William O. Bell, M.D., I.T. Thomas, M.B., B.Ch.
(Winston-Salem, NC)

The association between congenital anomalies of the distal spinal cord and the distal vertebral column, sacrum, hindgut, and urinary tracts is poorly understood. However, on the basis of current theories on the interrelationships of the caudal cell mass, hindgut, and distal urinary tracts, it is logical to assume that maldevelopment of one will affect development of the others.

Over the last ten years at our institution, we have examined six children with either caudal regression or cloacal extrophy in association with a truncated spinal cord, myelomeningocele, or spinal lipoma. The pathogenesis of these anomalies will be discussed in light of the findings for this unique group of patients.

ANOMALIES ASSOCIATED WITH ONS OF THE COMPLEX: A PRELIMINARY

Arthur Arand, M.D., William Ball, er, M.D. (Cincinnati, OH)

of the anorectal complex are with urinary tract and skeletal casion intraspinal anomalies have patients with anorectal te, prospective evaluation of the with anorectal malformations has not aken. We report our preliminary nts.

birth to 17 years) with anorectal tudied prospectively using metrizamide myelography and more onance imaging. Four patients were ater's association and two patients Down's syndrome. Thirteen of the 15 ed anomalies outside the central ine of 15 patients the position of the y low in which six were associated natis filum terminale. Urodynamics of ed neurovesicle dysfunction. cidence of intraspinal anomalies, we with anorectal malformations ne intraspinal axis. Investigation of ents at Children's Hospital Medical l malformations continues.

3. THE MALFORMED MERMAID: CLOACAL EXTROPHY AND TERMINAL MYELOCYSTOCELE

Alan R. Cohen, M.D., Mary L. Anderson, M.D. (Boston, MA)

Associations of uncommon developmental abnormalities can provide unique information about normal embryologic processes. The authors report their experience with 2 unusual associated malformations: cloacal exstrophy and terminal myelocystocele.

Cloacal exstrophy is an extraordinarily rare congenital malformation characterized by evagination of the intestines between 2 bladder halves, imperforate anus and omphalocele. During the past 3 years 5 children with cloacal exstrophy were examined at the New England Medical Center. All 5 children were found to have occult spinal dysraphism, and in each case the specific neurologic abnormality was a terminal myelocystocele.

The terminal myelocystoceles were evaluated with T1-weighted magnetic resonance scans of the thoracolumbar spine. In each case the study showed a tethered cord traversing a meningocele with localized cystic dilatation of the caudal central canal surrounded by fat. There was a variable degree of sacral dysgenesis.

The degree of neurologic dysfunction correlated with the size of the spinal lesion. Four children underwent surgical obliteration of the terminal myelocystocele and release of the tethered cord, all without change in neurologic status. Histology demonstrated an ependyma-lined cyst surrounded by fat.

RMED MERMAID: CLOACAL AND TERMINAL TOCELE

d terminal myelocystocele are each alies. The striking frequency with ther suggests a common defect of ent. Terminal myelocystoceles arise n undifferentiated cell mass at the bryo. In early development this ts the cloaca and allantois, re bowel and bladder. A focal tailbud closure of the posterior neuropore ng association of anorectal ccult spinal dysraphism. Terminal wed as part of a spectrum of ud dysgenesis.

4. DETERMINATION OF THE INCIDENCE AND CLINICAL SIGNIFICANCE OF THE ASSOCIATION BETWEEN ANORECTAL MALFORMATIONS AND SPINAL DYSRAPHIC STATES

Brad Mullin, M.D., Edward J. Kosnik, M.D. (Columbus, OH)

Recent reports have linked anorectal malformations with anomalies causing progressive neurologic deficit and sacral spinal defects. These reports are in contrast to previous reports which had considered these anomalies static. Consequently, these authors are recommending neurologic screening and possible neurosurgical intervention. In order to evaluate the natural history of these associated anomalies the patient population presenting to the Columbus Children's Hospital with imperforate anus and cloacal extrophy during the previous 18 years has been reviewed. These cases were then searched for patients who also carried the diagnoses of tethered spinal cord, myelomeningocele, lipomyelomeningocele, spinal cord lipoma, spina bifida, urinary incontinence and urinary retention. During this period, there have been 780 cases of imperforate anus and 15 cases of cloacal extrophy. Associated with the 780 cases of imperforate anus, there have been 2 cases of myelomeningocele, 1 case of neurogenic bladder and no documented cases of tethered spinal cord. Associated with cloacal extrophy there have been 3 cases of myelomeningocele, 1 case of imperforate anus with myelomeningocele, 1 case of imperforate anus with myelomeningocele, 1 case of urinary retention with imperforate anus and no cases of tethered cord. This data suggests that these associations, if

IATION OF THE INCIDENCE AND SIGNIFICANCE OF THE ION BETWEEN ANORECTAL ATIONS AND SPINAL DYSRAPHIC

tic and progressive follow-up (1-18 eal progressive neurologic deterioration ve secondary diagnoses. A recent t patients presenting with imperforate eened via plain film for sacral defects ld a large percentage of associated s. The most recent 100 cases of e currently being reviewed for sacral . Cases with sacral defects will then characterize these associations.

5. INTRAUTERINE REPAIR OF EXPERIMENTAL DYSRAPHISM: IMPLICATIONS FOR THE TREATMENT OF MYELOMENINGOCELE

Dan S. Heffez, M.D., John Aryanpur, M.D., John M. Freeman, M.D., Grover Hutchins, M.D. (Baltimore, MD)

Previously, we reported that, in the fetal rat, intentional exposure of the spinal cord to amniotic fluid results in paraplegia, kyphosis and necrosis of the spinal cord, (Pediatric Section Meeting, AANS, 1988). In the present study, we evaluated the feasibility of intrauterine surgery to repair the experimental dysraphism.

The Sprague-Dawley rat fetus underwent a 3 level thoracic laminectomy on day 18 of gestation. The dura was opened. In all cases, the fetal skin incision was left open and the fetus replaced in the uterus leaving the spinal cord in direct contact with the amniotic fluid. In the experimental group, the fetal skin incision was closed on day 19 of gestation in order to cover the spinal cord. Control rats underwent either a sham wound closure or no second procedure at all. In this group, therefore, the spinal cord remained exposed to the amniotic fluid. Gestation continued until term.

Each of the 6 rats from the experimental group was born with normal hind limbs and tail. Their wounds were completely healed. Spinal cord cyto-architecture was well preserved. Each of the 5 sham operated rats and each of the 8 controls not re-operated upon had severe deformities and weakness of the hind limbs and tail. In these rats, the skin incision had not

RINE REPAIR OF EXPERIMENTAL
ISM: IMPLICATIONS FOR THE
NT OF MYELOMENINGOCELE

histological evidence of extensive
.

e that the severe spinal cord injury
ntentional exposure of the neural tube
be prevented by protecting the spinal
erage. Possible implications for the
meningocele will be discussed.

6. TETHERED CORD AS A CAUSE OF SCOLIOSIS IN CHILDREN WITH A MYELOMENINGOCELE

James M. Herman, M.D., David G. McLone, M.D.
(Chicago, IL)

Of 100 patients with myelomeningocele and a tethered spinal cord, 51 patients presented with progressive scoliosis. After untethering, follow-up was obtained over an average of 4.1 years.

Five patients progressed requiring a fusion (all had a curve greater than 50°), 15 patients remained stable, and 31 patients showed improvement of at least 7° in their curvature with a range from 7° to 32°. Thirteen of the patients who improved had hydromyelia which was treated prior to or at the time of untethering. This left 18 patients who had improvement in their curvature from untethering in the absence of hydromyelia. Evaluation of these patients revealed the following: 1) seventy eight percent were female; 2) ninety percent of the patients had the spinal defect in the thoracic-lumbar or lumbar area; 3) all but one patient had a pre-operative curvature less than 50°; 4) maximum improvement occurred within six months after the untethering; and 5) post-operative motor improvement was noted in all 18 patients and gait improvement in 16 patients.

Implicating tethered cord as the cause of scoliosis, a significant number of these patients obtained stabilization or improvement from untethering of the spinal cord alone.

ENIC DYSPHAGIA RESULTING FROM ALFORMATIONS

D., Dachling Pang, M.D., Samuel
ttsburgh, PA)

l 1988, 15 of 46 patients (11 children, 4 went suboccipital craniectomy and my at our institution for Chiari sented with symptoms of progressive ction. Ten of the patients had severe sole or predoninant symptom complex attention was sought. Five other r swallowing dysfunction in association mptoms and signs of cervicomedullary se. Despite the often severe impairment ymptoms, diagnosis of the swallowing cognition of its significance was often patients, swallowing dysfunction was g to weight loss and recurrent nitis. In eight patients, dysphagia t of more global medullary impairment

affected patients, barium , supplemented by pharygoescphageal ageal pH studies were useful in defining ent of the swallowing impairment and in er perioperative nasogastric or gs should be implemented to maintain and minimize the risk of aspiration. The had widespread dysfunction of the nism with a combination of diffuse ophageal dysmotility, cricopharyngeal

7. NEUROGENIC DYSPHAGIA RESULTING FROM CHIARI MALFORMATIONS (Con't)

regurgitation, tracheal aspiration, and gastroesophageal reflux. The pathophysiology of these swallowing impairments and their relation to the symptomatic Chiari malformation is discussed.

Postoperative outcome with regard to swallowing function correlated with the severity of preoperative symptoms. All five patients with mild swallowing impairment showed rapid improvement after surgery. Six patients with more severe impairment, but without other signs of severe brainstem compromise such as central apnea, total bilateral abductor vocal cord paralysis, or quadriparesis also improved, albeit more slowly; all had resolution of swallowing dysfunction, confirmed in five by serial barium cine-esophagrams and motility studies. In contrast, the outcome in the four patients who developed other signs of severe brainstem compression before surgery was poor; only one patient showed significant improvement in swallowing function. Early recognition of the swallowing dysfunction and its significance and expeditious intervention are therefore crucial in insuring a favorable neurologic outcome.

ROGRESSION OF THE CHIARI ON

ce B. Storrs, M.D., Jeffrey
G. McLone, M.D. (Chicago, IL)

with myelomeningocele
linical deterioration attributed to
rogressive brainstem deformation
e mechanism for clinical
children with myelomeningocele
n were studied with serial MRI
y 5.1 years). The average
was 24.6 months. To examine the
f the Chiari II malformation,
were reviewed and
ne AP foramen magnum distance
McRae's line to the vermian peg
e in the ratio B/A was 0.14 (STD
num AP distance (4.16 cm.) in the
an published norms (3.40 cm.)
expected for norms. The Chiari
d patients is a dynamic process
scent of hindbrain contents.

9. ATLANTO-AXIAL INSTABILITY IN CHILDREN

Michael Muhonen, M.D., Arnold H. Menezes, M.D. (Iowa City, IA)

The occipital atlanto-axial region is the most complex in the axial skeleton. The developmental anatomy varies with age and the various stresses applied to this region. Atlanto-axial instability is more commonly seen in the pediatric population that suffers from developmental abnormalities, inflammatory processes, and traumatic events. In this presentation we review our experience over the past l2 years for this entity. 130 children were seen for atlanto-axial instability ranging in age from birth to l6 years. The most common causes were developmental abnormalities of the odontoid process (hypoplasias, os odontoideum), atlas assimilation with atlanto-axial instability and segmentation failures of the cervical spine, metabolic disturbances, Downs syndrome, trauma, and inflammatory states. Patients presented with a wide spectrum of complaints ranging from neck pain to quadriplegia. Neurodynamic investigations included plain radiographs, dynamic polytomography, MRI, and traction. CT myelography was used prior to the advent of MRI imaging. The biomechanics of each individual case was assessed. Immobilization was used as a primary mode of treatment in traumatic and inflammatory states. Irreducible lesions underwent decompression with the ultimate goal of having a stable fusion in all patients. There was no mortality, and the long-term follow-up has shown neurological recovery and no changes in the growth patterns.

NE INSTABILITY FOLLOWING
L DECOMPRESSION AND
IINECTOMY FOR
RI SYNDROME

David D. Aronson, M.D., Ralph H.

en from our myelomeningocele care
effects of suboccipital
vical laminectomy on cervical spine

n cervical spine radiographs are
Twenty children had previously
ccipital decompression and cervical
-Chiari syndrome (Group I) Fifteen
ingocele, who had not previously
pressed, served as our control
ompression averaged 33 months.
e age was 33 months. The
uated using the techniques of Cattell
e cervical translation, and of White
ne angular deformity.

%) of the children developed
y of the cervical spine. Translation
roup I averaged 5.O mm, and in
mm. This difference in translation
cant (p <0 001). Angulation at the
20 degrees in Group I, and 5.6
his difference in angulation was
(p< 0.001).

10. CERVICAL SPINE INSTABILITY FOLLOWING SUBOCCIPITAL DECOMPRESSION AND CERVICAL LAMINECTOMY FOR ARNOLD-CHIARI SYNDROME (Con't)

The results of this study demonstrate the high incidence of cervical spine instability following suboccipital depression and cervical laminectomy for Arnold-Chiari syndrome in the myelomeningocele patient, but the clinical significance is unclear.

E TO DECOMPRESS AND FUSE
PINAL CORD COMPRESSION AND
L INSTABILITY

Gordon McComb, M.D. (Los

ial instability which will not reduce
resent with clinical and/or imaging
d compression at this level. If the
ed to decompress the spinal cord, it
o fuse to the occiput which makedly
nas a higher incidence of non-union
fusion. Passing wires under the
ner compromise the compressed
these problems, we have utilized a
e mid-2 cm of the C_1 lamina is
ession, followed by placement of
ning lateral aspect of the lamina on
res are also passed beneath the
f C_2 and tightened over bilateral
ering the remaining arch of C_1 and
2.

d, we have used the described
patients (mean age 10.1 years) with
and subluxation. On admission,
its were present in 8, nuchal rigidity
d 1 asymptomatic patient who had
spinal cord compression. Following
usion of C_1-C_2 using the method
patients had progressive resolution of
all have achieved a stable fusion.

11. A TECHNIQUE TO DECOMPRESS AND FUSE C1-C2 FOR SPINAL CORD COMPRESSION AND ALANTOAXIAL INSTABILITY (Con't)

The described technique is a safe and effective method to treat patients with C_1-C_2 instability and spinal cord compression.

ERVERTEBRAL DISC
N (JIDC): RECOGNITION AND
T

lt Lake City, UT), Dachling Pang,

disc calcification (JIDC) is an
childhood, characterized by
eus pulposus of one or more
wo distinct groups of patients are
matic and a symptomatic group. In
p, disc calcifications are discovered
hs, whereas in the symptomatic
made by the sudden onset of
limitation of movement, fever,
hrocyte sedimentation rate, and
sis. Though disc protrusion may
ents, neurological signs are distinctly
t a patient with a herniated T2-T3
disc presenting with compressive
ent was followed expectantly, and
recovery.

sorder is unknown. The causes of
of the acute symptomatic episode
e.Calcification may be the result of
or morphological changes within the
ent. This calcification may remain
event may subsequently occur,
flammatory response within the disc.
response which gives rise to clinical
sociated with

eventual resorption of the disc calcification.

JIDC is generally a benign, self-limiting disease, seldom requiring operation. Recognition of the disorder is important to avoid unnecessary surgery. Resolution of symptoms and resorption of the disc calcification are the rule in symptomatic patients; recurrences are rare, as are residual radiographic changes.

AGNUM DECOMPRESSION IN LASTIC CHILDREN

I.D., Orest Hurko, M.D., Clara
nn Aryanpur, M.D. (Baltimore, MD)

lastic children underwent foramen
on at the Johns Hopkins Medical
984 and 1989. This has long been
gerous operative procedure and
der it too risky to advocate. Not only
undergo surgery, but 90% have
Utilizing appropriate techniques for
sue decompression, this procedure
d safe in experienced hands.

es will be presented as well as the
indicaitons before proceeding with
Additionally, common complications
cussed along with the appropriate
anagement of complex genetic
e neurosurgical intervention.

14. IMPROVEMENT OF CORTICAL MORPHOLOGY BY VENTRICULOPERITONEAL SHUNTS IN EXPERIMENTAL INFANTILE HYDROCEPHALUS

Lyn Carey Wright, M.D., (Salt Lake City, UT), Pamela M. Hale, B.S., (Philadelphia, PA), Steven D. Katz, B.S., James P. McAllister II, Ph.D. (Salt Lake City, UT)

As a sequel to our previous descriptions of the pathological changes that occur in the cerebral cortex during infantile hydrocephalus, the present study has evaluated the cytological and cytoarchitectural effects of surgical decompression. Hydrocephalus was induced in 4-11 day old kittens by intra- cisternal injection of 25% kaolin and monitored by ultrasonography. At 11-15 days post-kaolin (mean 12.7 days) animals with hydrocephalus received low pressure VP shunts (PS Medical). Shunted animals were monitored by ultrasound and sacrificed at 1, 2 and 4 weeks post-shunt. Normal age-matched animals served as controls. Tissue from cortical area 4 (motor), 22 (association) and 17 (visual) was processed for light microscopic analysis. Ventriculomegaly developed consistently and rapidly so that at the time of shunt placement the mean ventricular (biparietal) index (VI) was 0.57 (range 0.45 to 0.72). Within 3 days post-shunt the VI had reached 0.34 (control mean = 0.35), and was accompanied by dramatic improvements in behavior and skull ossification. However, during the second week several animals developed shunt malfunctions which required revision. Thus, about one third of the animals experienced a second period of ventriculomegaly. At sacrifice, nearly all animals exhibited mild to moderate ventriculomegaly, with cortical mantles

T OF CORTICAL MORPHOLOGY LOPERITONEAL SHUNTS IN AL INFANTILE HYDROCEPHALUS

ickness. Nevertheless, pyknotic or , which are found typically in vere rarely observed in areas 4, 22 na were prevalent, however, in the atter; occasionally small ed in the internal capsule. While all could be identified, the entire cortical ed, as evidenced by an increased rons. Furthermore, the somata of soriented, with apical dendrites ownward. Quantitative measures of tures are being performed and will these results indicate that, in spite of omplications, some of the teristics of the cerebral cortex are dings suggest that VP shunts may nage and/or promote neuronal repair.

15. SLIT VENTRICLE SYNDROME: ETIOLOGY AND TREATMENT

James Uselman, M.D., Edward J. Kosnik, M.D.
(Columbus, OH)

At the Columbus Children's Hospital during the period 1980 - 1989 approximately 500 patients were diagnosed and shunted for hydrocephalus. During that time period 29 children developed the slit ventricle syndrome requiring sub-temporal decompression. The children who required sub-temporal decompression were reviewed to possibly define an underlying common thread to attempt to predict which children would develop symptomatic slit ventricle syndrome. The etiology of hydrocephalus, number of shunt revisions prior to decompression, and age at which sub-temporal decompression was performed was recorded.

Intraventricular hemorrhage represented a disproportionately large number of children developing slit ventricle syndrome and ultimately required sub- temporal decompression.

Children with intraventricular hemorrhage and shunting are at increased risk to develop slit ventricle syndrome.

ELATION OF CHYMAL PRESSURE WITH ICULAR PRESSURE IN SLIT YNDROME

., Charles E. Nussbaum, M.D.,
M.D. (Rochester, NY)

irome" (SVS) is a clinical entity
nd symptoms of increased
n shunt dependent hydrocephalics
nal sized or small ventricles. The
me has not been proven
ed pathophysiologic mechanisms
unt malfunction, decreased CSF
age of CSF, increased intracranial
ticity of ventricular walls and
icity. Intraventricular pressure (IVP)
en used to aid the surgeon in the
yndrome. Extremely accurate
ssure (IPP) monitors are now
e and do not require ventricular
ecently cared for a patient with SVS
D IPP was monitored. The IPP was
while the patient was symptomatic
(25 mmHg) at the time of shunt
neuroanesthesia). This is the first
ge, clearly demonstrating a lack of
PP and IVP in SVS.

nce is thought to be caused by
tricles which would neither dilate as
it their elevated pressure to the brain
ch, IPP monitoring may be unreliable

17. SHUNTED AQUEDUCT HYDROCEPHALUS: CONTROL OF OVERDRAINAGE

Eldon L. Foltz, M.D. (Orange, CA)

Increasing recognition of overdrainage of CSF by ventricular shunts in hydrocephalus patients has focused attention on mechanisms. Whereas the "slit ventricle syndrome" is a diagnosis only by CT/MRI and low ICP by measurement, the "low ICP syndrome" is a serious symptom complex of severe headache, lethargy, emesis, and upward gaze - vision deficits associated with small to slit ventricles and strikingly low ICP when the patient is upright.

In our ongoing study of 38 patients with this low ICP syndrome, pre-operative ICP studies are the basis of determining the correction of ICP therapeutically needed. The shunted ICP correction has been achieved by using a zero pressure ventricular shunt system designed to control the upright ICP at normal negative levels (vertex as reference point). 34 patients responded very well, and symptoms disappeared promptly. CT scans showed enlarging ventricles in all 34, - follow-up now up to 18 months. The 4 patients with less than satisfactory responses required step-wise return to acceptable ICP with clinical stability.

The technical device in this ventricular shunt system which controls the upright negative ICP and corrects the clinical symptoms was originally designed as a "siphon control device", but in this system acts as a zero pressure device. It is effective in preventing overdrainage of CSF in VA or VP shunts because it controls the

QUEDUCT HYDROCEPHALUS:
F OVERDRAINAGE

rontal catheter, upright position) as
ion drainage (posterior catheter,
ntification of this system as a zero
ore appropriate. It is more than a
and controls the degree of negative
ition) by maintaining CSF pressure
t no lower than zero. Pressure
vice may be considerably negative
n water) but ineffective in
, - i.e. no overdrainage either by
n-siphon drainage.

n of this zero pressure device as
height from the vertex determines the
essure at vertex reference with
millimeters below vertex will equal the
zero reference, and the device at
the position indicated by the

solute pressure system acting as a
his is very different from our usual
are opening pressure valves based
functioning on pressure gradients

of this system will be reviewed. The
eries will be reported.

18. MEDICAL MANAGEMENT OF SLIT VENTRICLE SYNDROME

William G. Obana, M.D., Neil Raskin, M.D., Philip H. Cogen, M.D., Michael S.B. Edwards, M.D. (San Francisco, CA)

Slit Ventricle Syndrome (SVS) is characterized by chronic recurring headaches associated with normal or subnormal ventricular volume in shunted hydrocephalic patients. There appears to be three pathophysiological mechanisms which can cause this syndrome: 1) intermittent shunt malfunction due to an entrapped catheter between collapsed walls of ventricles or a partially obstructed shunt; 2) intracranial hypotension due to overdrainage or increased siphon effect with growth; and 3) paroxysms of increased intracranial pressure due to increased cerebral blood flow in the presence of decreased intracranial buffering capacity and normal shunt function. These patients have subnormal ventricular volume, small subarachnoid spaces, small calvariums, thickened skulls, and decreased compliance due to gliosis. We have treated the latter group with antimigrainous agents including inderal, midrin, elavil, periactin, and ergot derivatives. We report 4 patients who responded to antimigrainous therapy for SVS. There were three females and one male, ranging in age from 7 to 34 years. One had a single shunt operation, two had 4 shunt related operations, and one had 13 shunt related surgeries. The average time from the last shunt operation to the onset of headaches was 3 years. There was no characteristic location, frequency, or duration of these headaches. CT scans showed subnormal to normal ventricular volume and quantitative radionucleide shunt

normal in all patients. Two patients
ded at other hospitals with
ological deterioration. One had
headaches with elavil and midrin,
f with inderal, and one had
got derivatives. One patient stopped
ide effects. We suggest that
may be helpful in the treatment of
with normal shunt function and
due to paroxysms of increased
rom increased cerebral blood flow.

19. EXTERNAL VENTRICULAR DRAINAGE: A CLUE TO CSF SHUNT FUNCTION

James M. Drake, (Toronto, ON, Canada), Dr. Christian St. Rose, (Rue de Sevres, Paris), Dr. Marcia da Silva (MG, Brazil)

Little is known of the in vivo performance of Cerebrospinal Fluid (CSF) shunts. An external ventricular drain (EVD) most commonly implanted for the treatment of CSF shunt infection, functions very much like an implanted shunt.

We examined the minute to minute variation in EVD output in 9 children using a computerized monitoring system. There were wide fluctuations in flow rate, usually associated with activity, but some occurred with sleep. Flow rates in excess of 20 cc/hr were common and were sustained for several minutes. Periods of flow arrest also occurred.

To examine what other factors might contribute to EVD output, we reviewed the hospital records of 46 children who had received EVDs. The average EVD output was 6.33 cc/hr. EVD output increased with age and weight. Raising the height of the resevoir decreased EVD output. Patients infected with gram negative organisms or more than one organism had lower EVD output. The sex of the patient, the method of establishing the EVD, and the duration of the EVD had no effect. A model of the EVD output based on these parameters was constructed.

OF PERSISTENT
EGALY DUE TO ALTERED
ANCE

achling Pang, M.D., Erick
urgh, PA)

developing shunt malfunction are
ted by replacement with a shunt
ressure to that of the original
g that each brain system adjusts
s, its own accustomed pressure.
lfunctioning shunts show
ulomegaly and neurological
lacement of a new shunt with
essure than the pre-failure value.
obably explainable by altered brain
uring the initial shunt obstruction.

h hydrocephalus secondary to a
ch previously shunted with medium
presented with shunt obstruction,
and depression of consciousness,
eated with placement of a new
similar to the pre-failure valve. All 6
gross ventriculomegaly and
of that their new shunt systems
prescribed pressure. Moreover,
nd symptoms were unchanged or
unts were further revised with a
postulate that slow ventricular
tial shunt malfunction expelled

20. MANAGEMENT OF PERSISTENT VENTRICULOMEGALY DUE TO ALTERED BRAIN COMPLIANCE (Con't)

extracellular fluid (ECF) compartment of the brain and significantly increased the total brain compliance, so that the minimum intraventricular pressure required to sustain large ventricular volumes was accordingly lowered. This situation is further aggravated by the Laplace relationship between volume and wall tension, which dictates that the larger the attained volume, the higher the likelihood of its maintenance. It is also probable that the longer the duration of ventricular distention, the more profound the compliance alteration, and the greater the difficulty in attempting a reversal of the process.

According to this postulate, reversal must begin with drastic reduction of intraventricular pressure to initiate a reduction of ventricular size, replenishment of ECF water, and resumption of baseline brain compliance. Since a low pressure shunt system had uniformly been proven to be ineffective in causing ventricular shrinkage in all 6 patients, they were subsequently treated by replacing the shunt with an external ventricular drain gradually lowered to zero or subzero pressures. Slow but progressive ventricular shrinkage occurring over several days was accompanied by dramatic neurological recovery. They were then successfully re-shunted with either a medium or low pressure valve. Long term follow-up showed that all 6 patients remained well with normal ventricular size, suggesting that their brain compliance had returned to baseline.

M OF THE SYNDROME OF THE
RTH VENTRICLE IN THE CHILD
EPHALUS SECONDARY TO
AND
/INTRAVENTRICULAR
E

(San Diego, CA)

f the cerebrospinal fluid pathways
n the literature, and reports
the high risk newborn with
nial hemorrhage. We here report
d as common denominator
cular/intracranial hemorrhage, and
d an isolated fourth ventricle that
patients had been treated with
unts; their shunt systems controlled
a period of time until the isolated
sted itself. The presentation of the
occurred in a wide range period:
ven years following lateral ventricle
presenting symptoms ranged from
ullness of fontanelle and irritability in
ith swallowing, vomiting,
lethargy in the older child. The
ot had a fourth ventricle shunt
d only one operation for placement
shunt had a sudden death at two
e at home. He was found by the
iorespiratory arrest. All patients on
(or the single patient at autopsy)
nent of the fourth ventricle which

21. THE SPECTRUM OF THE SYNDROME OF THE ISOLATED FOURTH VENTRICLE IN THE CHILD WITH HYDROCEPHALUS SECONDARY TO PREMATURITY AND INTRACRANIAL/INTRAVENTRICULAR HEMORRHAGE (Con't)

had lost its normal shape and was rounded and was grossly out of proportion to the well decompressed lateral ventricles from the shunt procedure, at the time of diagnosis. All patients were treated with the placement of a fourth ventricle catheter through a paramedian occipital burr hole and connection to the existing ventriculoperitoneal shunt. Presentation will elaborate on the insidious forms of presentation of the disease process and the need for careful follow-up of the premature born with posthemorrhagic hydrocephalus, for this complication in the course of management.

S OF SHUNT FUNCTION

Michael Buonocore, M.D., Larry
, CA)

SF) shunt malfunction in patients
common and can result in prolonged
ve exploration or progressive
ne evaluation of shunt function
ve techniques that can be
mplications. Magnetic Resonance
nas been used to study both
and intraventricular CSF flow, may
ninvasive test of shunt function.

MR characteristic of flow related
del shunt system that was mounted
special section of tubing for MR
ed to maximize the signal of flow
This tubing was inserted into the
e valve. During experiments the flow
nodel was varied from 0-20 cc/hr.

ages were made (TR2000, TE20)
cialized tubing. The intensity of the
l at specific locations along this
flow" standard was measured. The
ed at several of these points varied
flow rate from 2 cc to 20 cc/hr.
t that MRI has potential for
ows present in a CSF shunt.

23. TRANSCRANIAL DOPPLER ULTRASONOGRAPHY FOR THE EVALUATION OF SHUNT MALFUNCTION

William M. Chadduck, M.D., H. Mark Crabtree, M.D.,
James B. Blankenship, M.D. (Little Rock, AR)

Previous studies have demonstrated a high correlation between clinically significant hydrocephalus and Resistive Index (RI) as determined by transcranial doppler ultrasonography. Resistive Index is calculated by dividing the difference between the peak systolic velocity and the end-diastolic velocity by the peak systolic velocity. Measurement of Resistive Index was attempted in 54 patients by insonation through the temporal squama or orbits, during evaluations for ventriculo-peritoneal shunt malfunctions; values were obtained in 5l. Indications of shunt malfunction in each patient included both clinical and radiographic evidence of increased intracranial pressure. Eleven patients referred for evaluation were determined to have functional shunts, both by clinical criteria and subsequent outcome. Shunt malfunctions were confirmed in 40 of the other cases. Prior to shunt revisions, these 40 patients had RI's of 71 +/- 10-%; following shunt revision, the RI's fell to 53 +/- I2%. Eight patients in this group had had premalfunction RI's of 47 +/- 5% determined during routine follow-up as outpatients; when they subsequently presented with clinical findings of shunt malfunction, their RI's had significantly increased. Six of the 40 patients with shunt malfunctions had essentially normal RI's (52 +/- %); their shunt malfunctions were usually characterized by partial or intermittent

AL DOPPLER
GRAPHY FOR THE EVALUATION
ALFUNCTION

n fluid tracking along the shunt
two instances, the RI's were well
e but dropped significantly after
mparison, 119 patients with clinically
eritoneal shunts had RI's of 50 +/-
a clear correlation of elevated RI's
, statistically significant based on the
t with a p value of < 0.001. Thus,
trasonography is a practical,
e useful in the diagnosis of
hunt malfunction.

24. SUPRASELLAR ARACHNOID CYSTS: CORRELATION OF SURGICAL MANAGEMENT WITH CT AND MRI SCAN FEATURES

Andrew D. Parent, M.D., Ossama Al-Mefty, M.D. (Jackson, MS)

Suprasellar arachnoid cysts tend to present with an unusual number of symptoms and are relatively difficult to manage. With increasing frequency, these cysts are diagnosed by MRI. We are adding eight cases of such cysts managed at our institutions in the past 10 years.

Five patients were children whose ages ranged from 4 to 10 years. Hormonal abnormalities were identified in three with diabetes insipidus in two cases and precocious puberty in one. Gait ataxia was noted in three cases but only one had headaches and visual field problems. Three children had learning difficulties characterized by inattention and poor memory. Among the three adult patients, whose ages ranged from 23 to 82 years, visual field defects were noted in three cases and headaches in two. None had endocrine, intellectual, or gait problems.

All patients had CT scan and four had MRI scans. The five pediatric cases had hydrocephalus associated with the suprasellar arachnoid cysts. Two patients were initially managed by ventriculoperitoneal and cyst-peritoneal shunts. Four patients were initially managed by craniotomy, three of whom required subsequent ventriculoperitoneal shunt. Two patients were managed by transsphenoidal fenestration of the cyst. There was no mortality in this group. Even after decompression of the cyst, diabetes

R ARACHNOID CYSTS: N OF SURGICAL MANAGEMENT MRI SCAN FEATURES

oth patients who had presented

suggest that intrasellar cysts with asmatic extension respond to on. A retrochiasmatic cyst is more st-peritoneal shunting than to xcision.

ens on all patients treated via nenoidal surgery were reviewed. studies did not provide new the pathogenesis of these cysts.

25. ANAEROBIC DIPHTHEROID INFECTION VERSUS CONTAMINATION – A STUDY OF CEREBROSPINAL FLUID CULTURES

Paul J. Camarata, M.D., Stephen J. Haines, M.D.
(Minneapolis, MN)

Propionibacterium acnes is an anaerobic, Gram positive rod often found as a contaminant in all types of cultures. The organism is prevalent in significant numbers on normal skin, and as such, is frequently found in relation to cerebrospinal fluid shunt aspirates. Partly because the pathogenicity of the organism is believed to be low and because it often takes several days for cultures to become positive, its presence in a CSF culture most often does not arouse clinical suspicion.

In an effort to identify those characteristics that might be useful in determining whether or not a CSF infection is indeed present, we examined the results of CSF cultures from January 1986 to June 1989.

Over this 30 month period, over 6300 CSF cultures were performed in our microbiology laboratory, yielding 770 different isolates. Of these, 102 cultures (13%) from 79 different patients were positive for anaerobic diphtheroids. The average time for the cultures to become positive was four days with a maximum of eight days. Ventricular shunts were present in patients in 40% of the cultures. Eight patients had multiple positive cultures, and six of these patients had shunts. These eight patients were treated with appropriate antibiotics for a recognized central nervous system infection, and 30 others

DIPHTHEROID INFECTION
NTAMINATION – A STUDY OF
INAL FLUID CULTURES

biotics for other intercurrent
nder of the patients received no

l prognostic features of this patient
sed, and an attempt is made to
s with the presence of an actual

26. DELAYED CEREBROSPINAL FLUID SHUNT INFECTION IN CHILDREN

Steven J. Schiff, M.D., (Philadelphia, PA), W. Jerry Oakes, M.D. (Durham, NC)

Infections in cerebrospinal fluid shunts are most common within the first weeks following shunt insertion due to organisms implanted at surgery. We have observed unusual delayed infections occurring years or decades after shunt insertion.

Cases of shunt infection at our institution were reviewed from 1979 to 1987. Twelve cases were identified where infections occurred more than 6 months following shunt insertion, in children aged 6 mo. to 17 yr. Seven had recent surgery or infections that immediately preceded shunt infection. For five patients, no antecedent surgery or infection could be identified as a presumptive source of infection, the delay to infection being 13 months to 11 years; the organisms isolated included Propionibacterium in 3 patients, 2 of which had mixed Propionibacterium and Staphylococcus epidermidis infections, alpha-hemolytic Streptococcus in 1, and in another patient no organism could be identified. The risk of late onset of infection for patients with shunts was less than 1% per year.

The specter of shunt infection occurring years or decades following CSF shunt implantation argues for lifetime follow-up of such patients and underscores the routine need for anaerobic culture techniques when infection is suspected.

KER SYNDROME: EXPERIENCE ES

M.D., Arnold H. Menezes, M.D.

me has undergone numerous anagement with contemporary . We reviewed thirty-one patients ndrome treated between 1959-1989 ent employed. There were 22 with a mean age of 4.3 years. included enlarging head (71%), ar complaints (26%), emesis (26%),), lethargy (9%), and seizures (6%). 26 patients (83%) included ocular berreflexia (11), mental retardation ny, gait impairment, and dysmetria (6 sis (2). Thirteen patients (41%) had abnormalities which included s callosum (6) and cardiac anomalies CT or MRI and by ventriculography

cluded posterior fossa exploration 11), shunting of cyst (3), and ricular shunt (10). Overall, there hs, all from posterior fossa lren died from non-surgical causes. itially treated with a combined shunt ly compared to 5/17 of the remaining mately, 22/23 surviving patients shunt. Overall, 93% of patients with proved

27. DANDY-WALKER SYNDROME: EXPERIENCE WITH 31 CASES (Con't)

compared to 41% with a cyst/ventricular shunting only. Mental retardation failed to improve in any patient regardless of management.

We advocate combined ventriculo-cysto-peritoneal shunting as optimal treatment as this resulted in neurologic improvement in the majority of patients.

PIGLET HIPPOCAMPAL PROTEIN
DEFICIT DURING REPERFUSION
GLOBAL CEREBPAL ISCHEMIA

.D., T.S. Park, M.D. (Charlottesville,

nimals that brain protein synthesis
eriod of impairment following cerebral
ts in energy metabolism and glucose
ered, was investigated in our
. Regional incorporation of
g, i.v.) in hippocampal substructures
ized piglets was quantified by
sitometry at 3 hours or 6 hours
10 minutes of global cerebral
subclavian and brachiocephalic
rmalized results (means ± s.e.; as
e shown below:

Leucine Incorporation

	3 hours reperfusion (n=5)	6 hours
	45 ± 6	59 ± 8
	36 ± 6	
	34 ± 5	
	38 ± 6	

28. NEONATAL PIGLET HIPPOCAMPAL PROTEIN SYNTHESIS DEFICIT DURING REPERFUSION FOLLOWING GLOBAL CEREBRAL ISCHEMIA (Con't)

Similar derangements in amino acid incorporation and protein synthesis that persist even after six hours of reperfusion following ischemia also occur in hippocampus of adult animal models. Such deficits may be responsible, in part, for the ultimate neuronal death these selectively vulnerable hippocampal cells experience as a result of temporary cerebral ischemia.

(Supported by American Heart Association, Virginia Affiliate 5-37453; NIH-NS21045 and 00924: United Cerebral Palsy Foundation R35O-87).

R EVOKED POTENTIALS FROM THE RAT

., (Scarborough, ON, Canada),
. (Toronto, ON, Canada)

notor evoked potentials do not
integrity of the ventral component of
use of its separate blood supply and
contained within, monitoring of the
tremely important. Recording of
entials (CEPs) may be a technique
purpose. However, prior to their
EPs should be evaluated in an animal
njury. Therefore, in this study, we
erized responses from cerebellar
CEPs were elicited by applying
al stimuli (I0 mA, 50 us, 8.1 Hz) to
ian lobule with a platinum stimulating
andwidth of 30-3000 Hz, 512
ded, averaged and replicated from
electrodes in the T9 spinal cord
ly from the sciatic nerves (CEP-N)
uscles (CEP-M). Lesions were made
of the cord using a #11 scalpel blade
Ps assessed.

of five positive and five negative
duction velocity was 53.2 m/sec
m signal definition typically occurred
er waves were attenuated with
of up to 190 Hz implying polysynaptic

29. CEREBELLAR EVOKED POTENTIALS RECORDED FROM THE RAT (Con't)

mediation of these waves. Thresholds were substantially different between the cord, nerve and muscle responses; the mean $\pm$ s.d.) values were: CEP-C 4.08 + 1.44; CEP-N 9.83 $\pm$ 3.60; and CEP-M 20.67 $\pm$ 3.79 ($p = 0.0001$). Unilateral cerebellar stimulation resulted in bilateral nerve and muscle responses. Left versus right cerebellar stimultation caused no consistent change in any of the potentials recorded from cord, nerve, or muscle. Dorsal column lesions, posterior hemisection, and bilateral lateral sectioning had little effect on the CEP-C while ventral hemisection abolished the response. In contrast, dorsal column lesions extinguished the CEP-N, and dorsal hemisection obliterated the CEP-M. Ventral hemisection spared the CEP-N and the CEP-M. Complete cord sectioning abolished all responses.

In conclusion, this is the first report of evoked potentials recorded following cerebellar stimulation in the rat and is the first to define the characteristics of the normal CEP. Monitoring of the cerebellar evoked potential provides a selective means of assessing the integrity of the ventral funiculus. This technique is potentially of great value for experimental spinal cord injury research and for the neurophysiological monitoring of the spinal cord in patients.

ALIZATION IN THE YOUNG
ILEPSY

chael S. Duchowny, M.D., Trevor
Alvarez, M.D. (Miami, FL)

tionally been reserved for the
ıtractable epilepsy. One of the
elaying surgical treatment has
cal localization in the young child.

ifty five patients in the pediatric
gically treated for their intractable
ıese patients were less than l2
1 year old, 5 between 1 and 3
dren 3 to 11 years of age).
ented with a well defined
4 hour multichannel telemetric
nd were operated upon (nine
two parietal/occipital

vever, had no epileptogenic focus
e recording. Nineteen of these
ectrodes placed under general
ent recording. Additionally,
were mapped in 1 cm.
en an epileptogenic focus was
rding. The functional mapping
ve surgery (11 temporal and 5
but two children were cooperative
e monitoring and extensive testing
d. Three children

30. CORTICAL LOCALIZATION IN THE YOUNG CHILD WITH EPILEPSY (Con't)

were operated on under local anesthesia (ages 6, 9, and 1O) and they all did remarkably well through a long tedious session of cortical mapping prior to resection. Young children required a higher current to evoke a cortical response than did older children and the functional areas of speech and/or motor function rarely conformed to any preconceived anatomical precepts.

Thus, cortical localization can be accomplished even in the very young child. This experience has shown further neurophysiological differences in the young child and the information has been valuable when contemplating a resective surgical procedure.

IODELING AFTER A WIDE
P CRANIECTOMY IN SAGITTAL
STOSIS

Maywood, IL), David G. McLone,
vski, M.D. (Chicago, IL)

l craniosynostosis deal with surgical
There are only a few reports on
phological changes. The recent
hnology, in particular,
(3-D reformat) of cranial CT, allows
ng of the remodeling process of the

1979 to 1988, there were 143
t surgeries for sagittal
r age ranged from 10 days to 7
ns). Males predominated over
studies included CT scan with or
kull x-rays, and neuropsychological
cal approach was a wide (usually
craniectomy. No alloplastic
Post-operative follow-ups included:
urement; 2. CT scan (+ 3-D
s and 1 year; 3. aesthetic
opsychological assessment.
s following a wide strip craniectomy

n process after the strip craniectomy
he posterior parietal area.

31. CRANIAL REMODELING AFTER A WIDE MIDLINE STRIP CRANIECTOMY IN SAGITTAL CRANIOSYNOSTOSIS (Con't)

2. The biparietal area (lambdoid to lambdoid distance) expands more noticeably than bifrontal area (coronal to coronal distance).

3. All children except for 2 who had pre-existing secondary congenital defects (1 with absence of corpus callosum and the other with pre-operative mental retardation) had an "excellent" result as demonstrated by cephalometry, CT findings, aesthetic, and neuropsychological test.

4. Surgery can be performed safely with no complications, zero infection and no morbidity.

ISSECTION IN PEDIATRIC S AND CRANIOFACIAL

, Stephen P. Beals, M.D.

e dissection combining a icroneedle" electrode and a ncy energy source achieves near ostantially reducing need for olended dissecting and coagulating eptional power control at low ng in less than a 5 degree C. on at 1 mm. Specific advantages laser, bipolar dissection, and the . Dissection of arachnoid or scar ms, or nerve-tumor is achieved stortion, no sparking, and no to a steam barrier effect, the 'no-touch," especially of value in egion and cauda equina. When nsecutive craniotomies and no healing or infectious concerns ontrasted to cold blade clips are no longer necessary. ated the use of cold blades for d ultrasonic surgical aspiration for these advantages.

33. SPINAL CORD INJURY WITHOUT RADIOGRAPHIC ABNORMALITY (SCIWORA) IN CHILDREN

Richard K. Osenbach, M.D., Arnold H. Menezes, M.D.
(Iowa City, IA)

SCIWORA occurs frequently in children and accounts for up to 67% of injuries in some series. SCIWORA occurs due to unique anatomical and biomechanical features of the pediatric spine. We present our experience with 31 cases of SCIWORA in children between 1970 and 1988, representing 35% of pediatric spinal cord injuries.

Etiology of injury included birth trauma/fall (10 each), MVA/athletics (5 each), and child abuse (1). Mechanisms of injury included flexion (15), longitudinal traction (10), hyperextension (5), and repetitive flexionextension (1) The cervical cord was involved in 26 (84%) cases, 19 in children below age 8. All 9 upper cervical injuries occurred below age 3. Most flexion injuries involved upper cervical levels in children below age 3; hyperextension injuries mainly involved the lower cervical cord in older children. All traction injuries occurred with birth trauma.

Neurologic presentation included complete cord injury (12), incomplete injury (11), central cord syndrome (6) and anterior cord syndrome (2). Delayed onset of neurologic deficit occurred in 7 children. Radiographic evaluation included plain and dynamic films with polytomography or CT to exclude occult fractures. Myelography, CT-myelography or MRI was performed to exclude disc prolapse or extradural

INJURY WITHOUT
IC ABNORMALITY (SCIWORA) IN

had 2 months of immobilization
mic studies to exclude latent
utcome was related solely to the
urologic injury.

RA should undergo MRI to
. Optimal management includes
all children with follow- up dynamic
nstability.

34. CEREBRAL BLOOD FLOW AND GLUCOSE METABOLISM IN EXPERIMENTAL BRAIN EDEMA

Leslie N. Sutton, M.D., David Barranco, M.D., Joel Greenberg, Ph.D., Stephen Dante, M.D. (Philadelphia, PA)

The relationship between white matter cerebral blood flow (CBF) and glucose metabolism (LCMRgl) was studied in a plasma infusion model of vasogenic edema in cats. LCBF as determined by iodoantipyrine was found to be significantly decreased in edematous white matter (17.3 $\pm$ 1.5 ml/100gm/min) when compared with contralateral control white matter (24.8 $\pm$ 1.8 ml/100gm/min). If the values for edematous brain were corrected for dilution, however, the LCBF averaged 25.3 $\pm$ 1.7 ml/100gm/min, which was the same as control.

LCMRg1 was found to be significantly increased in plasma-infused white matter (16.3 $\pm$ 2.2umol/l00gm/min) compared with control white matter (10.7 $\pm$ 1.3). This difference remained despite correction for dilution and recalculation of LCMRg1 values based on altered kinetic constants found in edematous brain. A similar increase in LCMRg1 was noted with saline infusion edema.

It is concluded that increased tissue water does not alter CBF, but does induce an increase in anaerobic metabolism.

Key words: brain edema, glucose, CBF, brain metabolism.

OF MINOR HEAD INJURY IN

ywood, IL), David G. McLone,

of children with trivial head injury
ological consequences.
vely small number of children has
Skull fracture, unconsciousness,
viewed as significant factors in
articularly in the adult population.
e (GCS) as an objective
cal function has limited usefulness
r those under 36 months of age.

eriences with 937 children with
odified CCS (Children's Coma
dy period from 1981-1986, 791
minor head injury (GCS or CCS
ge was 5.5 years. Males
es by 2:1 ratio. Fall was the most
r head injury followed by
accident. Seven hundred and
e "alert" on admission. Of the
gical lesions: 9 subdural
hematomas, 44 depressed skull
Two children (0.3%) with delayed
quent deterioration; one from
ma and one with diffuse cerebral

gth of unconsciousness, presence
n findings, post-traumatic

35. RISK FACTORS OF MINOR HEAD INJURY IN CHILDREN (Con't)

seizure, etc. are correlated with GCS or CCS.

Initial analysis showed the following observation:

1. Children with a loss of consciousness for more than 16 minutes had a 45 times greater risk of a poor outcome.

2. Of the 739 with GCS 13-15 and who were "alert" on admission, 99 (13.4%) had surgical lesions; 789 children (99.7%) had a good outcome except for 2(0.3%) who had the so called "Talk & Die" event.

3. Linear, basilar or closed depressed skull fractures did not affect the outcome. Children with diastatic and compound depressed skull fractures had a poor outcome in 50% and 14.3%, respectively.

4. Small punctate hemorrhage(s) or areas of contusion did not adversely effect the outcome compared to those wtih a normal CT.

5. Children with moderate or severe head injury had a 5 to 7 times higher risk of post-traumatic seizures than those with minor head injury.

6. Post-traumatic seizures had 2 times greater risk of poor outcome compared to those without seizures, however, post-traumatic seizures did not adversely affect a good outcome.

S OF MINOR HEAD INJURY IN

l state and GCS were the best
sequent deterioration or the presence
GCS 15 is not necessarily a safe
ecommend that a head CT scan be
atients with GCS 13 & 14, and GCS
ental state. Therefore, only those with
rmal mental state, no clear history of
ss or momentary loss of
and normal neurological findings may
ome to be observed by a competent

36. IS THERE A ROLE FOR IMMEDIATE OPERATIVE INTERVENTION IN ALL SEVERELY HEAD-INJURED CHILDREN?

Christopher Duma, M.D., Dennis L. Johnson, M.D.
(Washington, DC)

In the past decade improvements in the care of severely head-injured children have reached a disquieting plateau, and the therapeutic limits of managing intracranial pressure may have been reached. The clinical emphasis has changed to prevention and to expeditious delivery of care. We have previously shown that direct triage to a level 1 trauma center has a major impact on the mortality of head-injured children. Other authors have suggested that valuable time can be saved by bypassing CT and taking severely head-injured children with Glasgow Coma Score (GCS) of 3 or with signs of brainstem compression directly to the operating room for exploratory burr holes. Their preliminary results have shown a remarkable incidence of subdural hematomas (53%) and a slightly improved mortality rate in those who had hematomas.

We have looked at 41 consecutive children with GCS 3 to examine the value of immediate operative intervention. Children who were dead on arrival, who were intubated or pharmacologically paralyzed, or who were postictal were excluded. Thirty-four percent had other major injuries but all died of their head injuries. Motor vehicle accidents were the cause of injury in 58%: 29% were automobile passengers and 29% were pedestrians. Child abuse was responsible for 26% and bike accidents 9%. CTs were performed on all patients: 24% had an extracerebral hematoma greater than or equal to 5 mm in

A ROLE FOR IMMEDIATE E INTERVENTION IN ALL SEVERELY RED CHILDREN?

e of the children died, and only one pressed skull fracture).

mmediate operative intervention in d children with GCS 3.

37. CONTINUOUS EXTERNAL DRAINAGE IN THE TREATMENT OF SUBDURAL HEMATOMAS OF INFANCY

Sarah J. Gaskill, M.D., W. Jerry Oakes, M.D., (Durham, NC), Arthur E. Marlin, M.D. (San Antonio, TX)

The treatment of chronic and subacute subdural hematomas in infancy has evolved since Ingraham and Matson's initial monograph in 1944. Classically, these have been approached in a stepwise fashion. Initially daily subdural taps are performed, followed as needed by burr holes and historically craniotomy for drainage and resection of subdural membranes. Subdural-peritoneal shunting has been advocated by a number of authors and recently was described by Litofsky, McComb, et.al. as the treatment of choice for chronic subdural fluid collections in the pediatric population. The use of continuous external drainage in the treatment of infantile subdural collections has not been described in the literature, although it may be commonly used.

A series of l6 patients with chronic or subacute subdural hematomas treated with continuous external drainage is reviewed. Of these only 43.75% went on to require shunt placement. There were no complications in treatment. There was no clinical or laboratory evidence of infection in any case. Drains were left in place for seven days unless drainage markedly decreased at an earlier time at which point they were removed. No patient with early drain removal went on to subdural-peritoneal shunting. The outcome, measured by neurological examination, was

US EXTERNAL DRAINAGE IN THE
T OF SUBDURAL HEMATOMAS OF

n the shunted and non-shunted groups.

al subdural drainage of chronic and
s in infancy frequently is an effective,
This approach should be considered
rocedure prior to subdural- peritoneal

38. PRELIMINARY EXPERIENCE WITH LUMBAR DRAINAGE IN DIFFUSE PEDIATRIC HEAD INJURY

Hillel Baldwin, M.D., Harold L. Rekate, M.D. (Phoenix, AZ)

We present our experience with the use of external lumbar subarachnoid drainage in 3 children with severe diffuse head injuries. All patients had admission Glascow Coma Scale Scores of 8 or less and were initially treated with ventriculostomies. These children all manifested high intracranial pressures (ICP) refractory to maximal therapy including hyperventilation, lasix and mannitol, and barbiturate coma. In all patients ventricular drainage was at least attempted and in 2 of these patients drainage of cerebrospinal fluid (CSF) via the ventricular route was inadequate to control ICP. After the institution of lumbar drainage, all patients had an abrupt and lasting decrease in ICP. Two patients had conversion of their external lumbar drains to permanent lumboperitoneal shunts and are now recovering in rehabilitation facilities with functional outcomes. One patient died, most likely from uncontrolled ICP prior to institution of lumbar drainage.

We have formulated our rationale for lumbar drainage in diffuse head injury as follows: 1. It allows for the displacement of large volumes of CSF in the setting of collapsed ventricles that preclude drainage of adequate volumes to control ICP. 2. It encourages bulk flow from the brain extracellular fluid space into the ventricles where its removal from the system is enhanced by lumbar drainage. 3. Diffuse brain edema, indicated by high ICP,

RY EXPERIENCE WITH LUMBAR
IN DIFFUSE PEDIATRIC HEAD

atic subarachnoid hemorrhage lead to
oblem related to both basilar
nous outflow obstruction.

of diffuse head injury of childhood and
that may help select a patient
ill respond to this treatment modality

39. COMPLICATIONS OF ECMO REQUIRING NEUROSURGICAL INTERVENTION

Jeffrey Oppenheimer, M.D., (Los Angeles, CA), John F. Vogt, M.D., (Pasadena, CA), J. Gordon McComb, M.D. (Los Angeles, CA)

Between May 1985 and June 1988 at Huntington Memorial Hosiptal, 150 neonates of or beyond 34 weeks gestation were placed on extracorporeal membrane oxygenation (ECMO). The mortality rate for the group without this therapy was expected to be about 90%.

All neonates had cranial ultrasonography prior to the initiation of ECMO and daily while on ECMO (range 1-12 days, mean 4.5 days). If an abnormality was noted on ultrasonography, an unenhanced computerized tomographic (CT) scan of the head was obtained during the ECMO procedure.

A total of 135 patients had CT scans while on ECMO or shortly following its termination. Fifteen patients had no ultrasonographic abnormalities while on ECMO and were transferred back to the referring hospital after completion of ECMO without having had a CT scan at this hospital.

Of the total 135 patients with CT scans, 31/135 (23.0%) were found to have an abnormality. Of this group 22/135 (16 3%) had intracranial hemorrhage, and 9/135 (6.6%) other findings. Hemorrhages were often at multiple sites.

Neurosurgical intervention was required in 6/150 (4.0%). Two patients had the placement of a ventriculostomy, one epidural tap, one a craniotomy and two the

TIONS OF ECMO REQUIRING
RGICAL INTERVENTION

iculo-peritoneal shunt. Of the six
vo have significant developmental
ildly impaired. The survival rate for
s 137/150 (91.3%).

40. SERIAL ULTRASONOGRAPHIC EVALUATION OF NEONATAL VEIN OF GALEN MALFORMATIONS TO ASSESS THE EFFICACY OF INTERVENTIONAL NEURORADIOLOGIC PROCEDURES

Samuel F. Ciricillo, M.D., Michael S.B. Edwards, M.D., Klaus G. Schmidt, M.D., Norman H. Silverman, M.D., Grant B. Hieshima, M.D. (San Francisco, CA)

Two-dimensional echocardiography complemented with color flow imaging and pulsed Doppler ultrasound was used to evaluate one fetus and five neonates with a vein of Galen malformation who presented at birth with severe high-output congestive heart failure and cranial bruits. Intracranial blood flow through the vein of Galen malformations, cardiac status, and direction of aortic blood flow were assessed before and after staged interventional neuroradiologic treatment with transarterial and transvenous embolization procedures. Color flow imaging in each infant displayed the major vascular anatomy, including feeding vessels and the patterns of filling of the vein of Galen malformations. Pulsed Doppler ultrasound performed on the descending aorta above the diaphragm showed the degree of diastolic flow reversal indicative of runoff into the vein of Galen malformations. A reduction in blood flow through the vein of Galen malformation was seen on color flow imaging in four patients treated successfully by embolic procedures. The ratio of diastolic retrograde flow velocity in the descending aorta to systolic antegrade velocity decreased from 0.51 ± 0.15 (mean $\pm$ SD) to 0.15 ± 0.20 ($p < 0.05$). Color flow imaging and pulsed Doppler ultrasonography

TRASONOGRAPHIC EVALUATION
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rapy and the need for further treatment
n of Galen malformations.

41. STEREOTACTIC RESECTION OF PEDIATRIC VASCULAR MALFORMATIONS

Michael D. Partington, M.D., Dudley H. Davis, M.D., Patrick J. Kelly, M.D. (Rochester, MN)

The safety and efficacy of computer-assisted stereotactic resections of deep neoplasms has been well established. We report a series of 12 pediatric patients with supratentorial vascular malformations who underwent stereotactic resections at the Mayo Clinic between 1985 and 1988. The patients included 5 boys and 7 girls with a mean age of 8 years (range 3-16). Presenting symptoms were seizures in 8 children, hemorrhage in 3 and 1 lesion was incidentally diagnosed. Five patients had normal neurologic exams, 4 had hemiparesis, 2 had mental status changes only and 1 had a visual field defect.

All patients underwent stereotactic angiography and CT scanning--in 7 the lesions were angiographically occult. Computer-assisted stereotactic cranio- tomies were performed in all cases with no operative mortality or permanent morbidity. Follow-up was obtained in all cases at a mean interval of 25 months (range 5-45). No new deficits were detected in the previously normal patients. Of the remaining 7 patients, 6 had complete recovery of function and 1 was unchanged. In the 8 patients who presented with epilepsy, 7 children (87.5%) were seizure-free, of whom 3 were off anti-convulsants. The mean follow-up interval of these patients was 23 months (range 12-36). The other patient experienced a reduction in seizure

CTIC RESECTION OF PEDIATRIC MALFORMATIONS

ve cases are also presented. We
tactic resection of pediatric vascular
e and effective, particularly in the
epilepsy, and should be considered
other therapeutic modalities, such as
rgery or conventional surgery,
ecise localization of the lesion is

42. USE OF GAIT ANALYSIS IN PATIENT SELECTION FOR SELECTIVE DORSAL RHIZOTOMY

Leslie D. Cahan, M.D., (Orange, CA), Jan Adams, M.S.P.T., Jacquelin Perry, M.D., (Downey, CA), Lauren Beeler, R.P.T. (Trabuco Canyon, CA)

Selection of patients for selective dorsal rhizotomy (SDR) has been emphasized as being important to optimize results of this surgery. We have reviewed the pre- and postoperative instrumented gait analysis of 22 ambulatory patients who have undergone SDR looking for correlates of improvement after surgery that can be used to help in patient selection.

Good candidates for SDR have spasticity in calf, hamstrings, quadriceps and hip adductors. At least 3 out of these 4 muscles should show spasticity preoperatively. One patient who had spasticity only in hamstrings only showed improvement in knee motion, but no change in hip or ankle motion.

Assessment of the child walking barefoot should pay special attention to the ankle position. A good candidate for SDR has equinus foot position especially in the stance phase. Care should be taken to note that the equinus foot position is in fact due to spasticity and not contracture.

Characteristically these children walk in a "crouch gait". Two mechanisms contribute to the crouch: spasticity of the hamstrings and weakness of the calf muscle. To the extent that SDR alleviates hamstring spasticity, there will be decreased crouch postoperatively. If,

AIT ANALYSIS IN PATIENT N FOR SELECTIVE DORSAL IY

abnormally dorsiflexed preoperatively, surgery will be clinically significant and .

ent ambulator with obstructive ally a good candidate for SDR, be taken in recommending surgery to alkers. Preoperative examination etermining whether there is adequate or weight bearing. If ambulatory EMG ttle quadriceps activity and mostly calf xtensor activation, SDR may not be of improving ambulation.

to be an important factor in selection through 23 have all shown about the provements after surgery.

43. "ADJUNCTS IN THE EVALUATION AND TREATMENT OF SPASTICITY"

Ann-Christine Duhaime, M.D., (Philadelphia, PA), J. Parker Mickle, M.D., Michael Mahla, M.D. (Gainesville, FL)

While many children referred for evaluation for selective dorsal rhizotomy have clear-cut pure spastic diplegia, a number of pediatric and adult patients with less classical presentations provide diagnostic and therapeutic challenges to the neurosurgeon. These include patients with marked rigidity, dystonia, increased tone related to etiologies other than prematurity, overweight or weak patients, and those with total-body involvement such as opisthotonic posture. We have developed a screening procedure which entails creating a temporary afferent block by using l/4% Marcaine instilled epidurally. A lumbar epidural catheter is used to instill the local anesthetic in adults while a caudal block is performed in children. Patients are monitored for skin temperature changes and plethysmographic widening of the pulse pressure in the lower extremities to test for the presence of sympathetic blockade, and muscle tone, strength, sensation, and abnormal movements are observed before, during, and after blockade. Based on the response to epidural blockade and other factors, patients are then recommended for selective dorsal rhizotomy, chemical rhizotomy using intrathecal l2% phenol solution in glycerol, or non-neurosurgical treatment. We present the rationale for this approach and report our preliminary results using this technique.

E DORSAL RHIZOTOMY - SOME
L QUESTIONS

M.D., Mark A. Moret, M.D.

g of sensory lumbo-sacral rootlets
rative EMG recording is rapidly
ment of choice for lower extremity
cerebral palsy. We have reviewed our
ith this operation in 50 patients, asking
ions:

difference by level or side in the number
designated as abnormal and sectioned?
rder of sectioning influence the number
cut?
tter if constant current or constant
mulation is used for testing?
ize of rootlet tested affect the response
tlet?
method of threshold determination affect
se to stimulation?

58 roots in 50 patients. Of 4,174
sted, 3,209 (76.9%) were sectioned.

each side of the patient

44. SELECTIVE DORSAL RHIZOTOMY - SOME TECHNICAL QUESTIONS (Con't)

was approximately equal. However, a slightly larger percentage of rootlets were sectioned on the left as compared to the right (79 versus 74.7 percent). This was true at each root level except for L3 and S2. The order of testing and sectioning does not appear to influence the likelihood of sectioning a rootlet. Likewise, rootlet size has no apparent effect on the response to stimulation. There is no apparent difference between constant current and constant voltage stimulation except that we have found motor threshold determination easier with the constant voltage stimulator. The threshold of sensory rootlets can be determined equally well with single or trains of stimuli.

Selective dorsal rhizotomy appears to be relatively insensitive to minor variations in technique. Further technical refinements probably will require a better understanding of the physiology underlying the abnormalities identified intraoperatively.

TIES ENCOUNTERED IN TREATING TY

New York, NY)

ars over 400 children with hypertonicity ed at New York University Medical

of these individuals have undergone zotomies to treat their spasticity. While by the potential of this procedure to propriate individuals, we have also been isks of serious complications in treating tion. These patients are at an increased intraoperative bronchospasm and ation pneumonia. Two to three percent s will experience a transient neurogenic 40% will experience painful e feet or severe incisional pain and postoperative period. As a result of patient management protocol has C which has decreased our rate of ations and improved our postoperative ol and the rationale behind it will be

46. ALTERATION IN HIP SUBLUXATION FOLLOWING SELECTIVE DORSAL RHIZOTOMY IN CEREBRAL PALSY

Christopher I. Shaffrey, M.D., T.S. Park, M.D., Mark E. Shaffrey, M.D., Lawrence H. Phillips, II, M.D. (Charlottesville, VA)

Hip subluxation and dislocation are frequently present in patients with cerebral palsy. Currently, multiple orthopedic procedures are routinely performed with varying degrees of success attempting to prevent progressive hip incongruity. We examined whether selective dorsal rhizotomy alters hip incongruity in children with cerebral palsy.

Forty-three patients with spastic paraplegic or quadriplegic cerebral palsy have undergone selective dorsal rhizotomy with subsequent follow-up of longer than six months. All the patients had adduction and flexion contractures of the hip consistent with the severity and duration of muscle imbalance. The percentage of femoral head uncovering which is an index of hip subluxation was determined by serial hip x-ray analyses. It is widely accepted that normal patients have femoral head uncovering of less than 15%; patients at risk for progression to subluxation have uncovering of 15 to 33%; and actual subluxation is present when there is greater than 33% uncovering. Accordingly, the patients were divided into three groups, depending on the percentage of uncovering.

On preoperative examination, 7% of patients were normal, 60% were at risk, and 33% were subluxed. There were no patients with hip dislocation. Postoperatively, hips were

N IN HIP SUBLUXATION FOLLOWING
DORSAL RHIZOTOMY IN CEREBRAL

ovement, worsening, or lack of change
one year following surgery.
defined as a decrease in femoral head
or greater. Worsening was defined as
oral head uncovering of 10% or greater.
ents, 33% worsened and 66% remained
ng surgery. Among patients whose hips
worsened, 58% remained unchanged,
d following surgery. Among patients who
n preoperatively, 29% worsened, 21%
e, and 50% improved. Overall, 86% of
ange or an improvement in hip

results suggest the efficacy of selective
n the treatment of hip subluxation in
ral palsy.

47. LONG-TERM FOLLOW-UP ON RESULTS OF SELECTIVE DORSAL RHIZOTOMY FOR THE RELIEF OF SPASTICITY IN CEREBRAL PALSIED CHILDREN

Richard H. Tippets, M.D., Marion L. Walker, M.D., Katerine L. Liddell, R.N., Diana L. Ploeger, RPT (Salt Lake City, UT)

Quantitative improvement in lower extremity range of motion and improvement in function was assessed in cerebral palsied children who underwent selective dorsal rhizotomy (SDR).

Twenty two patients who have been followed at least two years after surgery were reviewed. After a pre-operative screening, patients underwent a uniform operative procedure utilizing intraoperative EMG. Limitation in range of motion (ROM) was quantitatively graded as severe, moderate, mild, or normal at the hamstrings, hip abductors, and ankle dorsiflexors and goals of attainment or improvement in quality of a posture or function were compared pre- and post-operatively.

Improvement in ROM was quantitated. Of the patients with severe involvement of hip flexion/extension, 50 percent improved. Of patients with moderate involvement of hip flexion/extension and ankle dorsiflexion/plantar flexion, all improved in their ROM. Over 80 percent of patients mildly affected in hip abduction/adduction and ankle dorsiflexion/plantar flexion were improved to normal. Generally, patients with severe limitation of ROM showed less improvement than those moderately or mildly affected. Approximately 80% of patients attained their goal of improvement in quality of function. No peri-operative or

I FOLLOW-UP ON RESULTS OF DORSAL RHIZOTOMY FOR THE SPASTICITY IN CEREBRAL PALSIED

ations were encountered. No patients'
. No patient showed a regression of
oal had been attained.

excellent functional means of improving
en coupled with intensive physical
t in improved function in patients with
nose with mild or moderate limitation in
ely to be improved by the procedure and
patient selection is critical for attaining
surgery.

48. ELECTROPHYSIOLOGIC EVIDENCE FOR AFFERENT FIBERS IN HUMAN VENTRAL NERVE ROOTS

Mark E. Shaffrey, M.D., Lawrence H. Phillips, II, M.D., Christopher I. Shaffrey, M.D., T.S. Park, M.D.
(Charlottesville, VA)

The Law of Bell and Magendie holds that dorsal spinal roots mediate only sensation and ventral roots mediate only muscular and glandular activity. Cerebral palsy patients who undergo selective lumbosacral dorsal rhizotomy rarely demonstrate sensory impairment despite sacrificing a majority of dorsal rootlets. One tenable explanation postulates the existence of afferent fibers in the ventral spinal roots.

Fourteen children with spastic diplegia underwent intraoperative sural nerve (purely sensory) stimulation with subcutaneous electrodes placed at ankle level prior to receiving selective dorsal rhizotomy. Twelve patients had both legs tested, two patients had one leg tested. Ipsilateral ventral and dorsal root recordings were performed concurrently with sural nerve stimulation from the L-3 to S-2 levels using bipolar platinum hook electrodes. Responses were signal averaged and stored on disk. Onset latency, amplitude, and area under the response curve were measured.

Dorsal root responses were seen after sural nerve stimulation from the L-3 to the S-2 levels. The largest response amplitudes were seen at the S-1 level in 74%, the L-5 level in 15% and the S-2 level in 11% of legs tested.

PHYSIOLIGIC EVIDENCE FOR T FIBERS IN HUMAN VENTRAL NERVE

onses were consistently recorded with erve stimulation. Responses were afferent in the majority of cases. e amplitude was noted at the S-2 level in -1 level in 38% of legs tested. Total area se curves were approximately 50% less oot response. The response latencies stent with those of myelinated fibers.

s electrophysiologic evidence for the ent fibers in human ventral roots. This ain the preservation of sensation with rsal rhizotomy.

49. THE POSTOPERATIVE DRAWINGS OF HARVEY CUSHING: THE PEDIATRIC BRAIN TUMORS

Eugene Rossitch, Jr., M.D., Matthew R. Moore, M.D., Peter McL. Black, M.D. (Boston, MA)

Harvey Cushing was a skilled surgeon and artist. As a surgeon, he performed over 2000 brain tumor operations and wrote classic monographs on meningiomas, acoustic neuromas and pituitary adenomas. His artistic talents were expressed in his postoperative drawings, of which brain tumors comprised a substantial portion.

As part of a project to recover many of Cushing's unpublished drawings, we are reviewing the archived surgical histories from the Peter Bent Brigham Hospital. Thus far we have found nearly one hundred of Dr. Cushing's drawings. His surgical histories are well documented containing not only the drawings, but also photographs of the gross and microscopic pathology as well as pre- and postoperative pictures of the patient.

About 25% of these sketches depicted operations performed on children. The most commonly drawn childhood tumors were craniopharyngiomas and gliomas of the brain stem and cerebellum. Less common drawings were of medulloblastomas, pituitary adenomas, and pineal region neoplasms. This presentation will focus on Cushing's pediatric cases and illustrate how he used these sketches to keep detailed records of his surgical experience.

We will also present sketches of tumor histology as drawn by Dr. Louise Eisenhardt, Cushing's pathologist. These sketches of the histology accompanied

OSTOPERATIVE DRAWINGS OF HARVEY NG: THE PEDIATRIC BRAIN TUMORS

ative notes and drawings. In our results it dent that Cushing's love for medical art ce on keeping detailed records had a e on his associates at the Brigham.

50. FOURTH VENTRICLE ASTROCYTOMAS IN CHILDHOOD

Tadanori Tomita, M.D., David G. McLone, M.D., (Chicago, IL), Masaharu Yasue, M.D. (Tokyo, Japan)

Fourteen children with solid astrocytomas occupying the fourth ventricle are presented. They represent 33% of 42 patients with astrocytic tumors of the cerebellum/fourth ventricle treated since 1981. Histology showed benign astrocytoma in 11, glioblastoma in 2 and gemistocytic astrocytoma in one. These tumors were often invasive to the floor (7 cases) or the wall (4 cases) of the fourth ventricle. At initial posterior fossa craniotomy, only 5 patients had visible complete resection, whereas 8 patients had radical subtotal resection leaving a sheat of tumor next to the brain stem. One patient had a partial resection, but total resection was done at the second craniotomy. During the follow-up period, 2 patients with glioblastoma died due to recurrence despite postoperative radiation therapy (RT), and another patient with gemistocytic astrocytoma died of E. coli sepsis 10 days after surgery. All other 11 patients are alive, and did not have postoperative RT. However, three patients needed further surgical resection of recurrent tumor: Two of them received RT subsequently. Remaining 9 patients did not have recurrence without RT over 1 to 8 years follow-up. Neurological complications of surgical resection are as follows; transient cerebellar mutism in 2 after the first surgery, and facial-abducens palsy in 2 and transient MLF sign in 1 after radical tumor resection at the second surgery. In conclusion, fourth ventricle astrocytomas

TH VENTRICLE ASTROCYTOMAS IN
HOOD

or perhaps originate from the brain stem.
reduction, with amputating the tumor at the
or, provides pleasing results without RT.

51. CHOROID PLEXUS TUMORS: TRENDS IN DIAGNOSIS AND MANAGEMENT

Curtis A. Dickman, M.D., Harold L. Rekate, M.D., Stephen Coons, M.D., Peter C. Johnson, M.D. (Phoenix, AZ)

Thirteen patients with primary choroid plexus tumors (CPT) were treated surgically at our institution during the past 20 years. There were 10 papillomas (CPP), 2 carcinomas (CPC), and 1 atypical papilloma (ACPP). Nine children (mean age, 3 years) and 4 adults (mean age, 35.5 years) presented with tumors of the cerebellopontine angle (n = 1), fourth ventricle (n = 5), or lateral ventricle (n = 7). Twelve patients presented with signs and symptoms of hydrocephalus, but only 2 required permanent shunts.

Ninety-two percent follow-up was obtained (mean 34.5 months). Three deaths occurred: one in a CPC with a postoperative hemorrhage and two in CPPs with recurrences of subtotally resected lesions. All patients treated with total tumor resection including tumors with atypical or malignant features, have survived without tumor recurrence. The operative microscope and improvement in anesthetic and monitoring techniques have facilitated total tumor resection and have reduced our perioperative mortality to zero.

Enhanced MR imaging assists in planning an operative approach and is the procedure of choice for detecting residual tumor postoperatively and for monitoring for tumor recurrence. The angiographic delineation of the vascular supply to these tumors retains usefulness for operative planning.

D PLEXUS TUMORS: TRENDS IN
SIS AND MANAGEMENT

sis remains the hallmark of diagnosis
differentiation of CPC from CPP.
cal studies may aid in distinguishing
CPP when the histological features are
and in distinguishing CPTs from
ow cytometry was obtained in 10
ot helpful in differentiating benign from

52. INFRATENTORIAL EPENDYMOMAS IN CHILDHOOD: PROGNOSTIC FACTORS AND TREATMENT

Gregory B. Nazar, M.D., (Louisville, KY), Harold J. Hoffman, M.D., Laurence E. Becker, M.D., Derek Jenkins, M.D. (Toronto, ON, Canada)

The prognostic factors and survival data for 35 children with surgica11y treated childhood infratentorial (IT) ependymomas at the Hospital for Sick Children in Toronto during the years 1970-1987, were analyzed. Tumor histology was reviewed individually and grouped into three categories (I-III) for survival analysis. An overall 5 year survival of 44.6% was obtained after the exclusion of peri-operative mortality. Factors which were associated with an improved five year survival were total tumor removal, non-invasive tumors, category I histology, age greater than 6 years, and absent physical signs of parenchymal invasion or lower cranial nerve involvement. Five year survivals were worse when associated with category III histology, brain stem or cranial nerve signs, age less than 2 years, tumor invasion and/or cranial nerve involvement, and subtotal tumor removal. Clinical evidence of spinal metastases was found to be uncommon (3.1%). Surgical excision followed by radiation therapy was the primary mode of treatment for these tumors. Controversies regarding tumor histological classification, the volume of radiotherapy to be delivered and the use of adjuvant chemotherapy are discussed.

IOUS ANGIOMAS IN CHILDREN

M.D. (Boston, MA)

t years, the author has operated on
der the age of eighteen for cavernous
ew in the cerebral hemispheres, three in
in the cerebellum, one in the thalamus
al cord. Focal neurologic deficits were
in 11 children, and seizures in the other
nonstrated evidence of recent
en of the sixteen patients. MRIs
ed lesions with areas of low and high
nsistent with hemorrhage or blood
. Family histories were detected in
ultiple lesions in four. Four lesions,
m and one in the thalamus, were
d because of their critical locations;
ion has rebled after follow-ups of up to
f accessible lesions was
removal being readily accomplished
ues. Intraoperative ultrasound was
everal deep lesions. There were no
condary to surgery in any of the
nsient increase in pre-existing deficit

are being diagnosed with increasing
of the most common vascular
children. More data are needed
low-up and natural history in order
ophylactic surgery for incidentally
ns of this type.

54. PEDIATRIC PITUITARY TUMORS

Souheil F. Haddad, M.D., Arnold H. Menezes, M.D., John C. VanGilder, M.D. (Iowa City, IA)

A retrospective review of all pediatric pituitary tumors with symptom onset before the age of 16 years was done from 1979 to 1989 to help define their pathological distribution, clinical presentation, treatment and prognosis.

Fourteen patients were encountered; ten had prolactinomas and four had ACTH secreting adenomas. The mean age at onset of symptoms was 12.75 years ranging from 6.5 to 16 years. There were a total of 12 girls and 2 boys.

The four patients with ACTH secreting adenomas were all females who presented with cushinoid features. The mean age at onset of symptoms was 10.5 years. The adenomas were all sellar and were resected transphenoidally with complete resolution of their endocrinological and clinical abnormalities.

There were 8 girls and 2 boys with prolactinomas. The mean age at onset of symptoms was 13.6 years. All the females presented with either primary or secondary amenorrhea; the tumors had extended outside the sella in four cases.

Initially transphenoid resection was performed, 3 patients remain recurrence free 1 to 6 years post operatively, 2 had symptom recurrence accompanied with moderate elevation of prolactin levels (up to 46) but without obvious tumor recurrence, one necessitated repeat

resection of a recurrence and two were lost
The two boys presented with massive
tension, reguiring an average of three
dures and radiation therapy for tumor
s recurrence free 9 years after diagnosis and
a stable residual tumor 4 years later.

55. MANAGEMENT OF CHIASMAL/HYPOTHALAMIC GLIOMAS OF INFANCY AND CHILDHOOD WITH CHEMOTHERAPY ALONE: PRELIMINARY EXPERIENCE WITH NITROSOUREA-BASED REGIMENS

Joseph A. Petronio, M.D., (Philadelphia, PA), Michael S.B. Edwards, M.D., Michael Prados, M.D., (San Francisco, CA), Victor A. Levin, M.D. (Houston, TX)

Between March 1983 and February 1989, nineteen infants or children with newly diagnosed or progressive chiasmal/hypothalamic gliomas were treated at the University of California, San Francisco with chemotherapy alone. Patients ranged in age from 0.28 to 15.58 years (median, 3.91) at the start of therapy. Twelve patients were treated immediately following diagnosis because of progressive symptoms, while an additional seven received chemotherapy following either radiographic progression or clinical deterioration. Histologic diagnosis was available in 12 patients; 7/12 (58%) tumors were classified as juvenile pilocytic astrocytomas, 2/12 (17%) as astrocytomas, 2/12 (17%) as highly anaplastic astrocytomas, and 1/12 (8%) as a subependymal giant cell astrocytoma. The incidence of associated neurofibromatosis was 4/19 (21%). While two initial patients were treated with non-nitrosourea-based regimens, the remaining seventeen patients received nitrosourea-based therapy; fifteen were treated with a five-drug regimen utilizing 6-thioguanine, procarbazine, dibromodulcitol, CCNU [1-(2-chloroethyl)-3-cyclohexyl-1-nitrosourea)], and vincristine. For 18 evaluable patients initially managed with chemotherapy alone, the response or

...MENT OF CHIASMAL/HYPOTHALAMIC ...S OF INFANCY AND CHILDHOOD WITH ...HERAPY ALONE: PRELIMINARY ...NCE WITH NOTROSOUREA-BASED ...IS

...as 15/18 (83%). Median time to tumor ...t been reached with a median follow-up ...ge, 6.6 to 302.9), and no tumor-related ...ed with a median follow-up of 78.8 ... to 322.4) from the initiation of therapy. ...erapeutic salvage of the four patients ...ssed following chemotherapy was ...rovement or stabilization of visual ...ed in 16/18 (89%) patients. No patient ...e in endocrine function while on ...patients required pharmacologic ...inopathy that was present at ...f therapy included transient nausea ...ients, reversible myelosuppression in ...-related peripheral polyneuropathy in ...xyurea-related skin rash in one ...inary results suggest a potential role ... cytotoxic regimens in the initial ...mal/hypothalamic gliomas of infancy ...g the clinician to potentially supplant ...n radiotherapy with its associated ...roup.

56. IMMUNOTOXINS AND PEDIATRIC BRAIN TUMORS

Karen M. Muraszko, M.D., Charles Riedel, M.D., Virginia Johnson, M.D., Walter Hall, M.D., Stuart Walbridge, M.D., Richard Youle, M.D., Edward Olfield, M.D. (Bethesda, MD)

Immunotoxins are a new class of chemotherapeutic reagent, which are composed of a monoclonal antibody covalently attached to a peptide toxin. The monoclonal antibody targets the conjugate to the surface of tumor cells bearing the appropriate antigen, following which the toxin penetrates the cell membrane and inactivates protein synthesis.

Ricin is a powerful protein toxin that is purified from the castor bean. Using recombinant DNA technology, the pure A chain subunit of this toxin can be produced. Recombinant ricin A chain (rRA) possesses the full ribosome inactivating ability of the native toxin, but lacks the B chain mediated binding and internalization activity of the intact ricin. Diptheria toxin is produced by a bacteria and also acts to shut down protein synthesis within a cell. A new, genetically engineered toxin called CRM 107 is identical to Diphtheria toxin except for two amino acid changes in its B chain. This mutant only lacks the binding activity of the native diphtheria toxin.

Transferrin receptors (TfR) are expressed on proliferating cells, most notably hematopoeflc cells and tumor cells. We have found TrR to be markedly elevated on medulloblastoma derived cell lines and medulloblastoma surgical specimens (4.8 x

ceptors/cell). 454A12 is an
in receptor antibody.

he potential use of immunotoxins in
thecal spread of various tumors.
ein synthesis inhibition assay, we
A12-rRA and 454A12-CRM107
an tumor cells (medulloblastoma and
y cultures from surgical specimens) at
een 3.9×10^{-12} to 1.1×10^{-10} M. In
rhesus monkeys, we have shown
concentration of these immunotoxins
intrathecally without toxic effects.
n immunotoxins is dose related. It
ataxia and loss of coordination.
seen as solely as changes in the
cell loss). This effect may serve as
evere toxicity is reached. It has been
ree species and with various
d to these toxins. These experiments
egion in which efficacy (tumor killing)
toxicity avoided. We will discuss the
animal findings for adult human trials
eoplasia and in the pediatric
eningeal leukemia, and ependymoma

57. DNA CONTENT AS A PROGNOSTIC FACTOR IN MEDULLOBLASTOMAS

Deborah E. Schofield, M.D., J. Russell Geyer, M.D., Mitchel S. Berger, M.D. (Seattle, WA)

DNA content (ploidy) was determined on nineteen medulloblastomas diagnosed at Children's Hospital and Medical Center between 1974 and 1985. Tumor ploidy was then compared to clinical outcome (disease free survival), as were age, sex, extent of resection, and chemotherapy. All children but one received radiotherapy. Of these factors, extent of resection and tumor DNA content seem to be of prognostic value with respect to these tumors.

	ANED	DOD
ANEUPLOID		
Subtotal/biopsy	3 (4,5,10 yrs)	0
Gross total	1 (3 yrs)	1 (3 yrs)
TETRAPLOID		
Subtotal	0	3 (1,3,5.5 yrs)
Gross total	2 (3,4 yrs)	0
DIPLOID		
Subtotal	0	5 (1m,1,3,4,4 yrs)
Gross total	1 (3 yrs)	2 (.5,2.5 yrs)
	1 (recur-3 yrs)	

NT AS A PROGNOSTIC FACTOR IN
ASTOMAS

ence of disease DOD- Died of

those children with aneuploid tumors
with diploid or tetraploid tumors.
om a gross total resedtion was
han those in whom a subtotal
ned, only if the tumor was tetraploid
tent.

58. CSF SHUNTS AND EXTRANEURAL METASTASES FROM PRIMARY CNS TUMORS: AN ANALYSIS

Brenda Baumeister, M.D., M.S. Berger, M.D., Paul M. Kanev, M.D. (Seattle, WA)

Children with brain tumors and CSF shunts have been described as having an increased risk of extraneural metastases. The utility of filters in preventing this problem has been questioned. We retrospectively analyzed our brain tumor patients, with or without shunts, to determine if shunt related metastases is a concern, and, if so, what factors are associated with this occurrence.

From 1968 to 1988, the charts of 415 pediatric patients with benign or malignant primary brain tumors were reviewed. Ages ranged from the neonatal period to 18 years. One hundred and fifty-two of 415 patients (37%) had a shunt placed (pre-op -- 45, post-op -- 94). Confirmation of extraneural metastases was based on clinical and diagnostic examinations. Factors analyzed were: a) SHUNT: type (VA, VP, etc.), valve, location, filter, revisions; b) EXTENT OF RESECTION; c) PATHOLOGY; d) TYPE 0F THERAPY.

Eight of 415 patients developed extraneural metastases during life. All eight patients had a medulloblastoma (cerebellar PNET). Five of eight (Group A) patients did not have a shunt (mean time, primary diagnosis to metastases, 15 months). Two children had a total resection. The predominant location of metastases (Group A) was: Bone (2); cervical lymph nodes (1); lung/bone (1); retroperitoneal pelvic mass (1). One of these patients had a simultaneous CNS recurrence. Three of eight (Group B)

AND EXTRANEURAL
S FROM PRIMARY CNS TUMORS:
S

ses had a shunt (VP-2/VA-I) placed
patient had a simultaneous CNS
ere no filters placed or revisions.
rimary diagnosis to metastases was
nt had a total resection. The
of metastases was bone (1),
mass (1), abdominal cavity (with
ilters were placed in patients with
velop metastases.

F shunts, regardless of type, location,
nsertion, do not predispose pediatric
nors to develop extraneural
osis of shunt-related metastases
ne development of intra-abdominal
A) dissemination primarily with or
s. The diagnosis of
n important factor while extent of
are not influential.

59. USE OF POLYMERS TO LOCALLY RELEASE CARBOPLATIN AND INHIBIT THE GROWTH OF WALKER 256 CARCINOSARCOMA

Alessandro Olivi, M.D., Michael L. Pinn, B.S., Matthew G. Ewend, B.S., Daniel W. Chan, Ph.D., Henry Brem, M.D. (Baltimore, MD)

We have developed a polymer controlled-release system capable of treating experimental brain tumors by interstitial chemotherapy. Currently lipid soluble drugs (Nitrosoureas) are being tested clinically.

In order to determine if water soluble drugs remain effective when incorporated into polymers for local administration, we tested Carboplatin, a Cisplatin analog, against the Walker 256 carcinosarcoma which is capable of growing in a solid mass in the rat flank and has been used as a model for meningeal carcinomatosis.

Carboplatin (7mg) was incorporated into ethylene-vinyl acetate copolymer cylinders (l4mg). In vitro kinetic studies demonstrated that approximately 12% of the drug is released over the first l0 days.

Walker 256 carcinosarcoma was implanted in the flank of 32 Sprague-Dawley rats. Four days later the animals were divided into 4 treatment groups: Group 1 received an intraperitoneal (IP) injection of Carboplatin (3Omg/Kg), implantation of empty polymer adjacent to the tumor and in the contralateral flank; Group 2 received Carboplatin-loaded polymer adjacent to the tumor, empty polymer contralaterally and IP saline. Group 3 had empty polymer at the tumor site, Carboplatin-loaded polymer

ERS TO LOCALLY RELEASE AND INHIBIT THE GROWTH OF ARCINOSARCOMA

saline. Group 4 (Controls) had
er acid and IP saline.

n) and Group 2 (local carboplatin
owed a significant tumor growth
and p=O.O5 respectively) when
ntrols.

ns its antitumor activity when
a controlled release polymer.

release of Carboplatin at the tumor
ne systemic toxicity associated with

nay add to the armamentarium useful
pediatric brain tumors.

60. GROWTH HORMONE FAILURE FOLLOWING RADIATION THERAPY OF PRIMARY BRAIN TUMORS

Paul M. Kanev, M.D., Mitchel S. Berger, M.D., John Lefebvre, M.D., Richard S. Mauseth, M.D. (Seattle, WA)

Many children have developed endocrine failure following radiation therapy for brain tumors. Growth hormone replacement therapy has become readily available since the development of genetically engineered hormone. We have reviewed the medical records of patients at Children's Hospital and Medical Center to assess the development of endocrinopathy following treatment and the success of hormone replacement.

81 children with brain tumors were cared for in 1986-1987, the first two years after synthetic hormone became available. Pathology was confirmed at craniotomy or following biopsy in 71 patients. Presumptive diagnosis was made by MRI in 10 children with optic pathway or brainstem tumors. 60 children received radiation therapy: craniospinal - 25 patients, and focal infratentorial - 10 patients. No postoperative therapy followed complete tumor resection in 11 children. Chemotherapy was the only treatment used in 6 children. The families of 4 children refused all treatment including surgery. 48 children who received radiation therapy were alive at the time of review and represent the study populations. Endocrine evaluation was initiated when growth was less than 4cm/year in children less than 4 years of age or when height fell to a lower growth percentile. Work-up included x-rays for bone age, T4, TSH and somatomedin-C levels. Growth hormone provacative studies followed 1-dopa and clonidine stimulation.

ORMONE FAILURE FOLLOWING
THERAPY OF PRIMARY BRAIN

ıor diagnosis in 1987 and 11 in
: stature and each had growth
epressed somatomedin-C levels and
e onset of delayed growth was 6-18
ɔn of radiation therapy and was most
ar after treatment. No child who
y only, had endocrine failure. 6 of
d hypothyroidism. The most
medulloblastoma and

ated with synthetic growth hormone
week. All children treated had
rowth velocity to 1.0cm/month was
no complications of treatment.

ne bone age and somatomedin-C
ierapy is begun. Endrocrinologic
v the first fall-off in height velocity.
ency approaches half of the
ation therapy within 2-3 years of
ne replacement, normal adult
ed.

61. THE SEARCH FOR THE PNET GENE

Corey Raffel, M.D. (Los Angeles, CA)

Intracranial primitive neuroectodermal tumors (PNET) are one of a series of tumors that occur predominantly in the pediatric population. Other tumors in this group include neuroblastoma, retinoblastoma, rhabdomyosarcoma, osteosarcoma, Wilm's tumor, and hepatoblastoma. Specific rearrangements or deletions resulting in a reduction from the heterozygous state to homozygosity have been identified on various chromosomes for all of these tumors but intracranial PNET. Hoping to identify similar genomic changes in patients with PNET, comparisons were made between tumor DNA and somatic DNA in a series of patients using the technique of Southern blotting. The DNA was examined for changes in restriction fragment length polymorphisms (RFLP) with a minimum of two DNA probes in regions of interest. The regions examined include chromosome 1p (neuroblastoma), 11p (Wilm's tumor, hepatoblastoma, rhabdomyosarcoma), and 13q (retinoblastoma, osteosarcoma). In addition, chromosome 10, which has been implicated in glioblastoma multiforme, and chromosomes 6q and 17p, which have been implicated in medulloblastoma on the basis of cytogenetic data, were also examined. A reduction to homozygosity has been identified on chromosome 17p in three of nine informative patients. In addition, two of eight informative patients showed a reduction to homozygosity on chromosome 6q. No more than one patient showed a reduction at any of the other loci examined. Thus, a tumor suppressor gene important in the oncogenesis of medulloblastoma may be located on chromosome 6q and/or 17p. Currently, work is in progress to determine the significance of the reduction to homozygosity seen in these patients.

CTOR RECEPTORS ON
RAIN TUMORS

Pittsburgh, PA), Marsha J. Merrill,
le, Ph.D. (Bethesda, MD)

as epidermal growth factor (EGF)
stimulate cell proliferation through
n-affinity cell surface receptors and
n and cell division in normal and
d states. Receptors for EGF have
n human squamous cell carcinoma of
oma, pancreatic carcinoma, and
ne. The TFN receptor has been
rcinoma and malignant melanoma.
roteins linked to monoclonal
geted to specific membrane
eoplastic cells to selectively kill

ber of EGF and TFN receptors on
obe and cerebellum)(n=2),
), and ependymoma (n=4) tissue
d a competitive radioreceptor assay
^{125}I-TFN. Frozen tissue samples
make a membrane preparation and
erformed on ice over 4 hours. After
centrifuged, bound radioactivity was
d analysis we determined the affinity
GF and TFN receptors to be 7.5 x
M^{-1}, respectively.

ot detected on normal brain or on
r tissue. All 4 ependymomas
EGF

62. GROWTH FACTOR RECEPTORS ON PEDIATRIC BRAIN TUMORS (Con't)

receptor levels. TFN receptors were undetectable on normal brain and ependymoma tumor specimens. Two medulloblastomas expressed significant levels of TFN receptors. By performing a comparative analysis between the counts obtained from the tumor samples and a primitive neuroectodermal tumor-derived tissue-culture cell line (TE-671), we were able to estimate the number of receptor sites per cell for each tumor sample. The number of EGF receptors/cell for ependymomas were estimated to range from 1000-6000 receptors/cell. The number of TFN receptors/cell for medulloblastomas were estimated to be 1400 receptors/cell and 8200 receptors/cell.

The demonstration of EGF receptors on ependymoma and TFN receptors on medulloblastoma suggests that these tumors may be susceptible to immunotoxin therapy. Ependymoma and medulloblastoma, both known to spread via cerebrospinal fluid pathways, may be treatable by the intrathecal administration of one or more toxin-antibody conjugates.

D., Francis Ali-Osman, D.Sc.

tomas are among the most
nsive pediatric brain tumors, drug
to be a major limiting factor to more
these tumors. In this study, we
acterized two human
lines (UW228 and UW287) and used
e role of 0^6-AT in mediating the
this common pediatric tumor to
a and compared the results with
nt astrocytoma cell lines of known
T activities were quantitated in cell
r cell line by measuring the transfer
ıp from an 0^6 -[^{3}H]-
o the AT protein in the cell extracts.
s quantitated in each cell line using
onogenic cell assay, and by
of DNA interstrand crosslinking
hese cell lines. We also investigated
itors of 0^6-AT, namely,
d streptozotocin on the
ne cell lines. The results
ereas UW287 had high 0^6-AT levels
otein), UW228 had half that level.
rated a spectrum of
ociated immunocytochemical markers
in the capillary clonogenic cell

63. O^6-ALKYLGUANINE-DNA-ALKYLTRANSFERASE IN HUMAN MEDULLOBLASTOMA: RELATIONSHIP WITH CHLOROETHYLNITROSOUREA RESISTANCE

assay. There was no significant potentiation of BCNU-sensitivity or BCNU-induced DNA-interstrand crosslinking in UW228, the cell line with the lower 0^6-AT level. These results are in agreement with our previous observation with human malignant astrocytomas and demonstrate that elevated 0^6-AT can be a significant basis for CENU-resistance of human medulloblastomas.

Supported by NIH, NCI, Grant CA46410, and NIH, NINDS Grant

ND COMPUTER ASSISTED
CTIC RESECTION OF DEEP
N CHILDREN

CSC, Dr. Michael Joy, Dr. Andrew
o, ON, Canada), Mr. David Kreindler
ada)

benign pilocytic astrocytomas in
longed survival. Tumours in the
ntricle are often unresectable by
We have developed a Computer and
system to approach these deep

of a computer graphics workstation,
Graphics, Mountain View, CA) and a
Vestinghouse Electric, Pittsburgh, PA).
ed directly by an IBM compatible
ne IRIS. Following application of the
me, standard CT images of the head
are obtained. AP and Lateral
are taken using a separate reference
es are transferred to the IRIS where
e tumour, ventricle, skull, are
re routines. The cerebral angiograms
toured manually.

display of the CT and angiographic
and simulation of the operative
erating room the BRW frame is
ne and robot are fixed to a rigid table.
rain retractor is introduced into the
e planned approach. The retractor is
d the

64. ROBOTIC AND COMPUTER ASSISTED STEREOTACTIC RESECTION OF DEEP TUMOURS IN CHILDREN (Con't)

position and orientation of the retractor displayed on the workstation. The tumour is excised by use of the CO2 laser attached to the operating microscope.

Radical excision of a deep seated pilocytic astrocytoma has been performed in one case using this system.

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