BRAIN ACTIVITY

ACADEMIC AND RESEARCH NEWS VOLUME 4 NUMBER 1

IN THIS ISSUE . . .

. . . we focus on Pediatric Neurological Surgery at UCSF. Children with neurosurgical disorders are cared for at The UCSF Children's Hospital on Parnassus Avenue in San Francisco. As a member of the National Association of Children's Hospitals and Related Institutions (NACHRI), UCSF joins the nation's best children's hospitals in a nonprofit network committed to excellence in children's services and to promoting children's health by education, research, and advocacy.

CONTENTS

COMPREHENSIVE TREATMENT FOR CHILDREN WITH BRAIN TUMORS

Childhood brain tumors are the second most frequent childhood malignancy and the most common form of solid tumor, according to the year 2000 Report of the Brain Tumor Progress Review Group for the National Institutes of Health/National Institute of Neurological Disorders and Stroke. In the United States, approximately 2,200 children under 20 years of age are diagnosed annually with central nervous system (CNS) tumors. The Central Brain Tumor Registry of the United States estimates that 2,899 new cases of childhood primary benign and malignant brain tumors are expected to be diagnosed in 2001.

Unlike adult tumors, 90% of which arise in the cerebral cortex, 50% of childhood brain tumors originate infratentorially, in the cerebellum, brain stem, or fourth ventricular region. The most common primary brain tumors in children are primitive neuroectodermal tumors/medulloblastoma, astrocytoma, and pilocytic astrocytoma.

The management of childhood brain tumors depends on the histological character of the tumor and its location within the nervous system. For example, childhood low-grade cerebellar gliomas may be curable with surgery alone in over 90% of patients, whereas for brain-stem gliomas, the prognosis for most children is death within 18 months of diagnosis.

Continued on page 2

Pediatric Neurological Surgery team from left to right: Drs. Nalin Gupta, Michael Prados, Mitchel Berger, Anuradha Banerjee, and Victor Perry. Not shown, Drs. Warwick Peacock and Michael Lawton.

LOOKING TO THE FUTURE

As a pediatric neurosurgeon myself, I hoped that one day I could bring together a group of bright, skilled, responsive doctors to establish a top pediatric neurosurgery team. I feel privileged to let you know about the team now working with me at UCSF and the Children's Hospital we work in. Nalin Gupta MD PhD, Director of our Pediatric Program, and Victor Perry MD have extensive training and solid experience in treating the neurosurgical disorders that affect children. Working with them are pediatric oncologist Anu Banerjee MD, who also has a special interest in palliative care, and Michael Prados MD, Director of Neuro-Oncology and principal investigator for the National Cancer Institute's Pediatric Brain Tumor Consortium site at UCSF. The noted epilepsy specialist Warwick Peacock MD works in our pediatric epilepsy program.

UCSF's Children's Hospital admits more than 6,000 pediatric patients each year – children referred from Northern California and around the world. They are cared for in our pediatric 'hospital within a hospital', with more than 150 beds in the Pediatric Intensive Care Unit (ICU), Neonatal ICU, and pediatric inpatient wards. UCSF has dedicated pediatric preoperative and postoperative facilities and a team of pediatric anesthesiologists responsible for all surgical procedures for children. When they go home, children who need further care continue to see their UCSF pediatric specialists at more than 50 outreach clinics in communities throughout the region, including a neurosurgical clinic being established in Walnut Creek. Many of UCSF's faculty specialists in pediatric care are also trained in another discipline, like neurosurgery, neurology, or anesthesia. Many have had fellowships requiring several years of training after residency to perfect their skill in a subspecialty discipline.

Our Pediatric Program offers the most advanced therapies available for childhood neurosurgical disorders, and we never forget our patient is a child. With support from the All Stars Helping Kids Foundation founded by San Francisco 49ers football star Ronnie Lott, UCSF now has an All Stars Technology Room, with twinkling lights across the ceiling and a computer networking system that lets children email, chat, or videoconference with other children in more than 80 hospitals throughout the United States. It's a valuable resource for helping dispel the feeling of isolation that can be so tough for children who must be in the hospital.

Mitchel S. Berger, MD

COMPREHENSIVE TREATMENT FOR CHILDREN WITH BRAIN TUMORS

Continued from page 1

Surgery followed by radiation therapy, chemotherapy, or both is standard therapy for most brain tumors. A tremendous technology-driven evolution in surgical capabilities now permits maximum surgical removal of tumor from the brain.

At UCSF, state-of-the-art therapy for pediatric brain tumors combines imaging before surgery with image-guided surgical navigation techniques that permit pediatric neurosurgeons Drs. Nalin Gupta, Mitchel Berger, and Victor Perry to see precisely a tumor's three-dimensional size and shape and its location at every moment during surgery. Brain mapping, a technique Dr. Berger helped pioneer, avoids injury to sites of language, motor, and sensory function. These techniques maximize resection of tumor and epileptic sites while minimizing adverse effects.

Gamma-Knife radiosurgery – a noninvasive procedure for certain smaller brain tumors – delivers a finely focused dose of radiation precisely to the tumor. The procedure entails little discomfort and a short time to recuperate. UCSF's radiosurgery team includes pediatric neurosurgeons, radiation oncologists, radiologists, and biophysicists. As for all procedures, the referring physician is consulted to be sure all variables affecting a child's responsiveness to therapy are considered.

After surgery, chemotherapy is often used for childhood tumors, especially medulloblastoma and chiasmatic glioma. As radiation therapy can affect developing brain, it often is not used for children under 3 years old. UCSF's Brain Tumor Center provides the most advanced neuro-oncology therapies available, together with neuropsychological consultation and close ties to organizations sponsoring support groups and resources for patients. A team of pediatric oncologists, pediatric nurse practitioners, social workers, and a school liaison specialist coordinate care and education for patients and their families. UCSF is a member of the National Cancer Institute's Pediatric Brain Tumor Consortium (PBTC) for clinical trials of new therapies. Dr. Michael Prados is principal investigator of this Consortium site at UCSF *(see article on page 3)*, and is assisted by pediatric oncologist Dr. Anuradha Banerjee.

Information for this article came from the following sources:

Reis LAG, Smith MA, Gurney JG (eds). Cancer Incidence and Survival among Children and Adolescents: United States SEER Program 1975-1995. National Cancer Institute, SEER Program, NIH Pub No 99-4649. Bethesda, MD, 1999.

Greenlee R, Hill-Harmon M, Murray T, Thun M. Cancer Statistics, 2001. January/February 2001. Vol 51, No 1. CA: A Cancer Journal for Clinicians. American Cancer Society, pp 31, 32.

CBTRUS (1999). Year 2000 Standard Statistical Report. Central Brain Tumor Registry of the United States, pp 7, 8, 14, 15, 17, 18.

focus on FACULTY

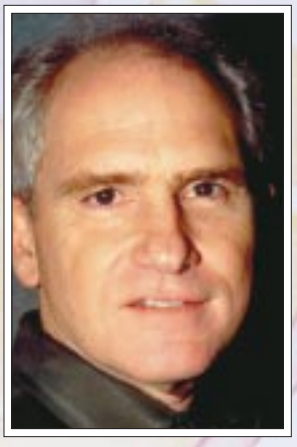
Characterizing Brain Tumor Genes To Develop New Treatments

Director of the UCSF Pediatric Neurological Surgery Program, Dr. Nalin Gupta focuses his research on the effect of therapeutic intervention on the progression of brain tumors. After surgery, the majority of malignant brain tumors in children are treated with either radiation therapy or chemotherapy. These modalities are designed to create cellular damage leading eventually to the death of tumor cells. The global and long-term biological consequences of cellular injury induced by these therapeutic modalities are still poorly described.

Dr. Gupta is currently exploring the use of newly developed DNA arrays to identify specific gene families that are expressed in brain tumors following irradiation. Initial data reveal that large numbers of genes, including various cytokines and transcription factors, respond coordinately to cellular stress. While technology such as these arrays can identify broad changes in mRNA or protein levels, these results can only narrow the search for potential targets of biologically directed agents. Detailed characterization of these genes will determine if they can be targeted successfully.

The use of these technologies may be the only way to achieve insight into the oncogenesis and progression of pediatric tumors that are particularly difficult to treat, such as malignant ependymoma, brain-stem glioma, and recurrent medulloblastoma. It is an explicit goal for Dr. Gupta and researchers in UCSF's Pediatric Neuro-Oncology Program to bring the results of such laboratory investigations to phase I clinical trials. Effective treatment strategies used today have been discovered only through such an approach.

Multicenter Search Underway for Innovative Pediatric Brain Tumor Therapies



To evaluate promising treatments for children who have brain tumors and to speed the development of innovative therapies, the National Cancer Institute (NCI) in 1999 established a Pediatric Brain Tumor Consortium (PBTC) of nine medical institutions. As principal investigator of the consortium site at UCSF, Dr. Michael Prados continues the clinical research trials of therapies for primary brain tumors that have been his focus for over 15 years.

The PBTC conducts rapid phase I and II clinical evaluations of new drugs, intrathecal agents, delivery technologies, biological therapies, and radiation therapy strategies in children who have primary tumors of the central nervous system. Several studies have begun, including: a trial for infants with embryonal tumors that emphasizes intrathecal chemotherapy in the hope of reducing the risk of spread throughout the neuroaxis; a trial of a novel agent for intrathecal use; and a trial of STI-571, a drug that selectively targets a unique receptor found on malignant glioma cells. STI-571 was designed specifically to target specific receptors found on various tumor cells, particularly in chronic myelogenous leukemia (CML), some rare solid tumors of the gut, and malignant glioma. One receptor altered by STI-571 is called the platelet-derived growth-factor receptor (PDGFR). Malignant astrocytes often express high levels of both the receptor and the gene, representing an opportunity to alter the growth signaling abnormalities associated with these tumors. STI-571 can be given daily by oral administration, and studies in adults have shown it to be very safe. Because of dramatic results of STI-571 in CML, the drug has been approved by the FDA for that specific indication.

Continued on page 4

FOCUS ON FACULTY, *Continued from page 3*

One of the major goals of the PBTC is to study agents like STI-571 in patients with newly diagnosed or recurrent disease. Several children with newly diagnosed brain-stem tumors, a highly malignant and lethal disease in most cases, have been enrolled in this study at UCSF. Another trial that will soon open has a similar strategy, using a specific growth-factor inhibitor called ZD1839, which targets epidermal growth-factor receptor (EGFR). EGFR is frequently over-expressed and mutated in malignant astrocytes. It can be given orally on a chronic basis and has had minimal toxicity in studies of adults.

(See Brain Tumor Update, inserted in this newsletter. Information about the trials can be found: at the PBTC Web site – www.pbtc.org or the UCSF Web site – cc.ucsf.edu/trials/pbtc006.html).

Prados, who was recently appointed Charles B. Wilson Professor of Neurological Surgery, is Director of the UCSF Clinical Neuro-Oncology Program and a Principal Investigator in the Brain Tumor Research Center. He also serves as Project Director for the National Cancer Institute's North American Brain Tumor Consortium. He has been a principal investigator, co-investigator, or collaborating investigator on over 35 research protocols of clinical therapy for malignant brain tumors and studies of quality of life for patients undergoing brain tumor therapies sponsored by the National Institutes of Health.

Dr. Gupta's Selected Publications

Gupta N, Vij R, Haas-Kogan DA, Israel MA, **Deen DF,** Morgan WF. Cytogenetic damage and the radiation-induced G1-phase checkpoint. Radiat Res 1996;145:289-98.

Khodarev NN, Advani SJ, **Gupta N,** Roizman B, Weichselbaum RR. Accumulation of specific RNAs encoding transcriptional factors and stress response proteins against a background of severe depletion of cellular RNAs in cells infected with herpes simplex virus 1. Proc Natl Acad Sci USA 1999;96:12062-7.

Pelizzari CA, Khodarev NN, **Gupta N,** Calvin DP, Weichselbaum RR. Quantitative analysis of DNA array autoradiographs. Nucleic Acids Res 2000;28:4577-81.

Gupta N, Nodzenski E, Khodarev NN, Yu J, Khorasani L, Beckett MA, Kufe DW, Weichselbaum RR. Angiostatin effects on endothelial cells mediated by ceramide and RhoA. EMBO Rep 2001;2:536-40.

Dr. Prados's Selected Publications

Simmons ML, **Lamborn KR,** Takahashi M, Chen P, Israel MA, **Berger MS,** Godfrey T, Nigro J, **Prados M, Chang S,** Barker FG 2nd, Aldape K. Analysis of complex relationships between age, p53, epidermal growth factor receptor, and survival in glioblastoma patients. Cancer Res 2001;61:1122-8.

Osoba D, Brada M, Yung WK, **Prados MD.** Health-related quality of life in patients with anaplastic astrocytoma during treatment with temozolomide. Eur J Cancer 2000;36:1788-95.

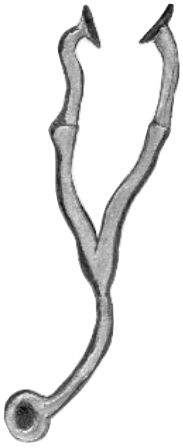
Levin VA, **Lamborn K,** Wara W, Davis R, Edwards M, Rabbitt J, Malec M, **Prados MD.** Phase II study of 6-thioguanine, procarbazine, dibromodulcitol, lomustine, and vincristine chemotherapy with radiotherapy for treating malignant glioma in children. Neuro-Oncol 2000;2:22-8.

Horn B, Heideman R, Geyer R, Pollack I, Packer R, Goldwein J, Tomita T, Schomberg P, Ater J, Luchtman-Jones L, Rivlin K, **Lamborn K, Prados M,** Bollen A, **Berger M,** Dahl G, McNeil E, Patterson K, Shaw D, Kubalik M, Russo C. A multi-institutional retrospective study of intracranial ependymoma in children: identification of risk factors. J Pediatr Hematol Oncol 1999;21:203-11.

NEW PEDIATRIC FACULTY APPOINTED

Pediatric neurosurgeon Victor L. Perry MD has been appointed Assistant Clinical Professor of Neurological Surgery. Dr. Perry received his MD from Yale Medical School.

He did his neurosurgical residency at Johns Hopkins Hospital and a fellowship in pediatric neurosurgery at the University of Pittsburgh School of Medicine. He specializes in pediatric neurosurgical disorders, including spinal dysraphism and other birth defects of the nervous system.



Pediatric neuro-oncologist Anuradha Banerjee MD, MPH has joined the Department of Neurological Surgery as Assistant Professor of Pediatrics & Neurological Surgery. Dr. Banerjee received her MD and her MPH in epidemiology from Tulane University. She did her residency in Pediatrics at UCSF and completed fellowship training at UCSF in pediatric hematology and oncology. Dr. Banerjee, who also has a special interest in palliative care, is working with Dr. Michael Prados in Pediatric Brain Tumor Consortium clinical trials. Her research concerns the role of molecular predictors of clinical behavior in childhood leukemia and pneumococcal vaccination in children undergoing chemotherapy.

NEUROSURGERY notes

Mitchel S. Berger MD, Professor and Chairman of the Department of Neurological Surgery, was recently appointed to the editorial board of the Journal of Neurosurgery.

Geoffrey Manley MD PhD has been appointed Assistant Professor of Neurological Surgery and Director of the Central Nervous System Injury Research Program at San Francisco General Hospital. Dr. Manley, who received his MD and a PhD in molecular neuroscience from Cornell University, completed his residency in neurosurgery at UCSF. Among Dr. Manley's research interests are investigations of brain oxygenation during hemorrhagic shock, resuscitation, and changes in ventilation by means of direct microelectrode monitoring of oxygen tension in brain tissue ($PbrO_2$), and the development of a model in which treatment protocols can be evaluated by using $PbrO_2$ as an end point.

Paul S. Larson MD has joined the Department as Assistant Professor of Neurological Surgery and Assistant Chief of Neurological Surgery at the San Francisco Veterans Affairs Hospital & Medical Center. Dr. Larson was graduated with honors from the University of Arizona Medical School, where he concurrently worked in the Graduate College's Program in Neuroscience and also at the Barrow Neurological Institute, studying the role of the cerebellum in motor control. He completed his surgical internship and neurosurgical residency at the University of Louisville. Dr. Larson's clinical interests are in stereotactic and functional neurosurgery, particularly with regard to movement disorders. His research interests include neurostimulation and neurotransplantation for neurological diseases including movement disorders and pain.

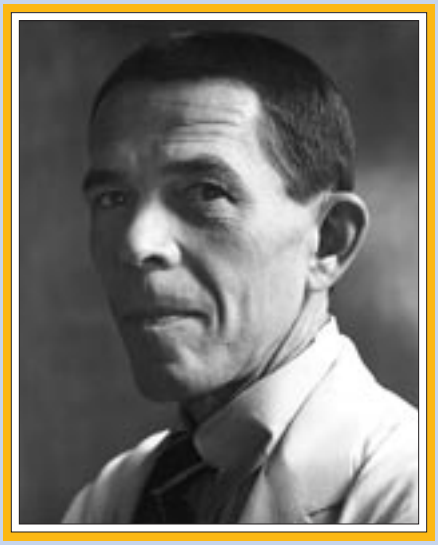
Charles B. Wilson MD has been awarded Tulane University's Distinguished Leadership Award, the highest tribute presented by the Tulane University Health Sciences Center. Dr. Wilson, Professor of Neurological Surgery at UCSF and a Director at the Institute for the Future, holds both undergraduate and medical degrees from Tulane.

The Pediatric Neurological Surgery Program at UCSF Treats the Following Conditions:

- Brain tumors
- Epilepsy associated with brain tumors
- Spinal-cord tumors
- Epilepsy
- Spasticity and cerebral palsy
- Pediatric cerebrovascular disorders
- Congenital and traumatic spinal disorders
- Chiari malformation
- Hydrocephalus
- Spina bifida

For Neurosurgery or Neuro-Oncology referrals and consultations, call 415-353-7500. Physicians can then press one additional number to reach an operator, who immediately will page the physician being called.

In June, Department Chairman Mitchel S. Berger MD announced establishment of the Charles B. Wilson MD Endowed Chair in Neurological Surgery. More than 50 donors, including former residents trained by Dr. Wilson, contributed generously toward the success of this effort. Dr. Wilson, who will retire early next year after 33 years of service to UCSF, chaired the Department of Neurological Surgery from 1968 through 1997 and is the founding Director of the UCSF Brain Tumor Research Center (BTRC). His research on the biology and treatment of malignant brain tumors has led to many scientific insights and clinical advances for patients with brain tumors.



UCSF Chancellor J. Michael Bishop has appointed Michael D. Prados MD to the Wilson Chair. Dr. Prados, who trained under Dr. Wilson, has served as Director of Clinical Neuro-Oncology since 1989. He is a Principal Investigator of the BTRC, Project Director for the National Cancer Institute's (NCI) North American Brain Tumor Consortium, and Principal Investigator in the NCI's Pediatric Brain Tumor Consortium. In announcing the appointment, Dr. Berger said, "Mike Prados is an outstanding clinician and researcher who is an excellent recipient of this great honor. Dr. Wilson's remarkable legacy will now be permanently linked to the many academic physicians he has trained and to this department, which he helped build to international prominence."

RESIDENTS FOR THE YEAR 2001 ARRIVE . . .

In July, the Department welcomed three new residents into the Neurological Surgery Residency Program. Kurtis Auguste received his MD from UCSF, where he was a recipient of numerous scholarships, including the Class of 1956 Alumni Scholarship. Auguste received funding from the National Institute of Neurological Disorders and Stroke for his postgraduate research in neuroscience at Children's Hospital, Harvard Medical School. His interest in underrepresented minority recruitment has led him to give recruitment lectures in California high schools and universities. He is currently a member of the UCSF School of Medicine Committee on Admissions. John Chi received his MD from Columbia University College of Physicians and Surgeons and his MPH from Columbia University School of Public Health, where he received a National Institutes of Health Student Research Award for his research on glioma immunobiology and the role of vasopressin in septic shock. Chi was a participant in Medical Outreach for the Homeless/Project Renewal in New York City, and Medical Relief Aid, a relief team in Masailand, Kenya. Justin Smith received his MD from Mayo Medical School and his PhD in molecular neuroscience from Mayo Graduate School. During his graduate education, he was the Sidney Luckman Endowed Physician Scientist at the Mayo Clinic and received the American Association for Cancer Research–Glaxo Wellcome Oncology Clinical/Translational Research Scholar Award. He has received funding from the National Brain Tumor Foundation and the American Brain Tumor Assocation for his research on genomic sequencing of a glioma tumor-suppressor gene. Smith organized a five-state project to collect medical literature for developing countries and worked in the Dorothy Day Homeless Shelter.

RESIDENTS' PUBLICATIONS

Chun JY, Smith W, Halbach VV, Higashida RT, Wilson CB, Lawton MT. Current multimodality management of infectious intracranial aneurysms. Neurosurgery 2001;6:1203-13.

Von Koch CS, Park TS, Steinbok P, Smyth M, Peacock WJ. Selective posterior rhizotomy and intrathecal baclofen for the treatment of spasticity. Pediatric Neurosurgery 2001 [in press].

Peacock WJ, Smyth MD. Selective dorsal rhizotomy for spasticity of PNS. In Batjer HH and Loftus CM (eds). Textbook of Neurological Surgery. Philadelphia, Lippincott-Raven, 2001 [in press].

Smyth MD, Peacock WJ. Spasticity. In Aminoff MJ and Daroff RB (eds). Encyclopedia of the Neurological Sciences. San Diego, Academic Press, 2001 [in press].

Quiñones-Hinajosa A, Halbach VV, Lawton MT. Conus perimedullary arteriovenous fistula with intracranial drainage. Case report. Neurosurgery 2001 [in press].

Vates GE, Wang KE, Bonovich D, Dowd CF, Lawton MT. Bow hunter's syndrome caused by a cervical disc herniation. Case report. J Neurosurg 2001 [in press].

Vates GE, Lawton MT. Central nervous system arteriovenous malformations. In Way LW (ed). Current Surgical Diagnosis and Treatment. New York, McGraw-Hill, 2001 [in press].

Vates GE, Auguste KA, Lawton MT. Fusiform, dolichoectatic and dissecting aneurysms: diagnosis and management. In LeRoux JP and Winn HR (eds). Diagnosis and Management of Cerebral Aneurysms. Philadelphia, Harcourt Health Sciences, 2001 [in press].

Vates GE, Arthur KA, Ojemann SG, Williams F, Lawton MT. Intraventricular hemorrhage from a central neurocytoma and an associated lenticulostriate artery aneurysm. Case report. Neurosurgery 2001 [in press].

Lawton MT, Vates GE, Spetzler RF. Management of posterior circulation aneurysms. In Winn HR (ed). Youman's Neurological Surgery. Philadelphia, WB Saunders, 2001 [in press].

Vates GE, Berger MS, Wilson CB.The diagnosis and management of pituitary abscess: a review of 24 cases. J Neurosurg 2001;95:233-40.

MATTHEW D. SMYTH MD

Matthew D. Smyth MD, currently Chief Resident in Neurological Surgery at UCSF Moffitt Hospital, can trace his career interest in pediatric neurosurgery back to his first neurosurgical rotation in medical school, nearly seven years ago, when he was exposed to a vast array of clinical problems, including congenital anomalies of the spine and cranium, intracranial and spinal tumors, spasticity, epilepsy, vascular lesions, CNS infections, and hydrocephalus. The experience impressed upon him the range of challenging disorders that a pediatric neurosurgeon is trained to deal with. Smyth notes that Drs. Warwick Peacock, Mitchel Berger, and Nalin Gupta all became strong mentors to him in this field.

Smyth is a graduate of Cornell University, where he was elected to Phi Beta Kappa and the Golden Key National Honor Society. He received his MD from UCSF. Having firmly established pediatric neurosurgery as a career goal during his residency, Smyth sought to gain laboratory experience that was in line with his interests. He spent his research year working in basic research on epilepsy with Dr. Scott Baraban in the Department's Epilepsy Research Center. Smyth was awarded the year 2000 Association of Neurological Surgery (AANS) National Research Education Foundation Fellowship for his research on pharmacoresistance in an animal model of cortical dysplasia, research that was also supported by a training grant from the National Institutes of Health. Smyth will present the results of this research at the upcoming Congress of Neurological Surgeons in San Diego. He is also using human neocortical tissue obtained from epilepsy resection surgery to examine models of burst activity and responses to both standard anticonvulsants and more novel compounds, including furosemide, which blocks epileptiform activity in human neocortex refractory to standard anticonvulsants. Smyth will present results from this work, which is being done with Dr. Baraban and Dr. Nicholas Barbaro, at the 2001 meeting of the Academy of Neurological Surgeons.

Smyth notes that a career in pediatric neurosurgery provides a unique opportunity to work on essentially the entire range of neurosurgical disorders and to focus his research interests in areas that can translate into improvements in patient care. However, the third important aspect that drew him to this field is the patients themselves. As a parent of two children of his own, he has a particular interest in helping children with neurological disease, as well as their families. Smyth adds that "this has proven to be one of the most rewarding and memorable aspects of my residency thus far."

"…helping children with neurological disease has proven to be one of the most rewarding and memorable aspects of my residency…"

This Newsletter is published by the UCSF Department of Neurological Surgery.

Editor
Pamela Derish
(pderish@earthlink.net)

Executive Editor
Susan Eastwood
(eastwood@neurosurg.ucsf.edu)

Photography
Len Blau
Pamela Derish
Jorge Marquardt

Design & Layout by Baseline Designs, San Francisco
Original design elements by Design Site, Berkeley
Original children's art by Ben and Noah

VISIT OUR WEB SITE
http://www.som.ucsf.edu/neuros/default.htm

– Selected Recent Publications from the Department of Neurological Surgery –

Alvarez-Buylla A, Garcia-Verdugo JM, Tramontin AD. A unified hypothesis on the lineage of neural stem cells. Nat Rev Neurosci 2001; 4:287-93.

Costello JF, Plass C. Methylation matters. J Med Genet 2001; 38:285-303.

Fanton CP, McMahon M, **Pieper RO**. Dual growth arrest pathways in astrocytes and astrocytic tumors in response to Raf-1 activation. J Biol Chem 2001;276:18871-7.

Hamilton JF, Morrison PF, Chen MY, Harvey-White J, Pernaute RS, Phillips H, Oldfield E, **Bankiewicz KS**. Heparin coinfusion during convection-enhanced delivery (CED) increases the distribution of the glial-derived neurotrophic factor (GDNF) ligand family in rat striatum and enhances the pharmacological activity of neurturin. Exp Neurol 2001;168:155-61.

Hashimoto T, Mesa-Tejada R, Quick CM, Bollen AW, Joshi S, Pile-Spellman J, **Lawton MT,** Young WL. Evidence of increased endothelial cell turnover in brain arteriovenous malformations. Neurosurgery 2001;49:124-31.

Hirose Y, **Berger MS, Pieper RO**. p53 Effects [sic] both the duration of G2/M arrest and the fate of temozolomide-treated human glioblastoma cells. Cancer Res 2001;61:1957-63.

Lawton MT. Comments on Naso WB, Rhea AH, Poole A: Management and outcomes in a low-volume cerebral aneurysm practice. Neurosurgery 2001;48:99-100.

Joint Writing Group of the Technology Assessment Committee, American Society of Interventional and Therapeutic Neuroradiology; Joint Section on Cerebrovascular Neurosurgery, a Section of the American Association of Neurological Surgeons and Congress of Neurological Surgeons; and Section of Stroke and the Section of Interventional Neurology of the American Academy of Neurology (**MT Lawton,** member): Reporting terminology for brain arteriovenous malformation clinical and radiographic features for use in clinical trials. Stroke 2001;32: 1430-42.

Hashimoto T, Lam T, Boudreau NJ, Bollen AW, **Lawton MT, Young WL**. Abnormal balance in the angiopoietin-tie2 system in human brain arteriovenous malformations. Circ Res 2001;89:111-3.

Hashimoto T, Mesa-Tejada R, Quick CM, Bollen AW, Joshi S, Pile-Spellman J, **Lawton MT, Young WL**. Evidence of increased endothelial cell turnover in brain arteriovenous malformations. Neurosurgery 2001;49:124-31.

Miao FJ, Janig W, **Jasmin L,** Levine JD. Spino-bulbo-spinal pathway mediating vagal modulation of nociceptive-neuroendocrine control of inflammation in the rat. J Physiol 2001;532(Pt 3):811-22.

Nguyen JB, Sanchez-Pernaute R, Cunningham J, **Bankiewicz KS**. Convection-enhanced delivery of AAV-2 combined with heparin increases TK gene transfer in the rat brain. Neuroreport. 2001;12:1961-4.

Ruan H, Su H, Hu, L, **Lamborn KR,** Kan, YW, **Deen DF**. Optimizing a hypoxia-regulated adeno-associated virus vector for cancer-specific gene therapy. Neoplasia 3(3): 2001.

Smiraglia DJ, Rush LJ, Fruhwald MC, Dai Z, Held WA, **Costello JF,** Lang JC, Eng C, Li B, Wright FA, Caligiuri MA, Plass C. Excessive CpG island hypermethylation in cancer cell lines versus primary human malignancies. Hum Mol Genet 2001;10:1413-19.

Sonoda Y, Ozawa T, Hirose Y, Aldape KD, McMahon M, **Berger MS, Pieper RO**. Formation of intracranial tumors by genetically modified human astrocytes defines four pathways critical in the development of human anaplastic astrocytoma. Cancer Res 2001;61:4956-60.

UCSF Department of Neurological Surgery
505 Parnassus Avenue, Box 0112
San Francisco, CA 94143-0112

Nonprofit Org.
U.S. Postage
PAID
University of
California
San Francisco