

Annual Report
Pediatric Neurotrauma Center
University of Pittsburgh
July, 2009

Summary

It was a year of accomplishments as well as transition for the Pediatric Neurotrauma Center of the University of Pittsburgh. The rigorous clinical team has been bolstered by investments of time by Critical Care Medicine faculty and the start of a dedicated Neurocritical Care Service. At the same time, the Neurosurgical Department has added two new faculty members and the founder of the PNTC, Dr. P. David Adelson, has moved on to Phoenix Children's Hospital. The superb clinical care continues due to the hard work of Neurosurgical residents, Critical Care Fellows, Nurse Coordinators, staff nurses and the combined efforts of faculty members from Critical Care Medicine, Neurosurgery and other departments. Clinical research is expanding at a vigorous pace, with the on-going Cool Kids trial and a phase I/II trial for a pharmacological intervention. There have been numerous presentations and papers at national meetings and several other grants are currently under review. Important initiatives are also underway for quality improvement, fundraising and development of a community advisory board.

Leadership

Michael Bell, Critical Care Medicine and Neurological Surgery – Director, PNTC
S. Danielle Brown, Neurosurgery – Manager, PNTC

Senior Advisors

Amin Kassam, Chairman, Neurological Surgery
Derek Angus, Chairman, Critical Care Medicine
Ian Pollack, Chief, Pediatric Neurological Surgery
Robert Clark, Chief, Pediatric Critical Care Medicine

Senior Contributors

Jeff Balzer, Assistant Professor, Neurological Surgery
Hülya Bayır, Assistant Professor, Critical Care Medicine
Sue Beers, Professor, Psychology
Rachel Berger, Assistant Professor, Pediatrics
Ericka Fink, Assistant Professor, Critical Care Medicine
Barbara Gaines, Associate Professor, Surgery
Stephanie Greene, Assistant Professor of Neurological Surgery
Miguel E. Habeych, Assistant Professor of Neurological Surgery
Kathy Higgins, Nurse Coordinator, Neurosurgery
Elizabeth Tyler-Kabara, Assistant Professor, Neurological Surgery
Patrick Kochanek, Professor, Critical Care Medicine
Mioara Manole, Assistant Professor, Emergency Department
Samuel Poloyac, Assistant Professor, Pharmacy
Stephen Wisniewski, Professor, School of Public Health

Junior Contributors

Alicia Au, Critical Care Medicine Fellow
Philip Empey, Research Faculty, Pharmacy
Ericka Jennings, Emergency Medicine Fellow
Matt Maserati, Neurosurgery Resident
Pawel Ochalski, Neurosurgery Resident
Veronica Ortiz, Medical Student II
Joan Sanchez del Toledo, Critical Care Medicine Fellow
Rosanne Salonia, Critical Care Medicine Fellow, T32 Awardee
Rebecca Smith, Critical Care Medicine Fellow, T32 Awardee
Craig Smith, Critical Care Medicine Fellow, T32 Awardee
Martina Stippler, Neurosurgery Resident

Clinical Care/Education Summary

Clinical care of children with traumatic brain injury continues to excel at the University of Pittsburgh. The physician care team consists of Neurosurgery faculty, Neurosurgery residents/fellow, Critical Care Medicine faculty and fellows and Pediatric residents. On March 1, 2009, the Critical Care Medicine Department instituted a specialized neurocritical care team to cover neurologically-injured children in the PICU. This group of physicians, Drs. Bell, Bayir, Clark and Fink, all have specialized interests in neurological injuries and bring considerable experience to this patient population.

We treated 112 patients with moderate to severe head injuries in the past year and 26 required protocol-based care with intensive neurological monitoring. Of all patients treated, there were 5 deaths (4 from suspected inflicted TBI, 1 from severe injury from a horse accident). We have implemented a prospective quality improvement practice to track expected and observed mortality rates for all children admitted to the PNTC. We will expand this effort with new liaisons with the Benedum Trauma Center of Children's Hospital of Pittsburgh in the coming year.

There were many educational sessions led by the PNTC. Danni Brown provided 2 in-services for the PICU nursing and respiratory staff regarding administration of hypothermia and providing consistent care to the head-injured child. She gave 3 lectures to the Pediatric Trauma Nursing course of the Benedum Trauma Center and lectured twice more at Critical Care Orientation. Lastly, she gave Nursing Grand Rounds to the University of Pittsburgh School of Nursing in discussing challenges to clinical research in children with traumatic brain injury. Dr. Bell performed several visiting professorships (Cornell University, New York, NY; Massachusetts General Hospital, Boston MA; New York Pediatric Critical Care Society, New York, NY; Children's National Medical Center, Washington, DC) to educate physicians and staff about the latest advances in care of the child with TBI. He was the Keynote Speaker of the Tampa General Hospital Annual Childhood Trauma Symposium and discussed experimental neuroprotective strategies for children after severe TBI. He gave

Grand Rounds to the Department of Pediatrics of the University of Pittsburgh School of Medicine regarding recent advances in the TBI and organized several journal clubs within the Department of Critical Care Medicine regarding controversies in pediatric neurocritical care. In addition, 6 Neurosurgical residents and 14 Critical Care Medicine fellows have learned the latest innovations of TBI while caring for the patients over the past year.

As a result, the clinical care and educational opportunities within the PNTC are broad and very active. We hope to recruit a dedicated fellow in Neurocritical Care from the specialties of Pediatric Neurosurgery, Pediatric Neurology and/or Pediatric Critical Care Medicine in the future to offer a broadened educational and clinical experience to talented young practitioners.

Research Summary

The ongoing research within the PNTC continues to be the most extensive body of clinical research in childhood head injury across the country. Dozens of important projects are ongoing, including the only interventional study in childhood traumatic brain injury within the US (Pediatric Traumatic Brain Injury Consortium: Hypothermia, or "Cool Kids"). Two ancillary studies to this trial were approved by the Cool Kids Steering Committee and the DSMB, including measuring the effect of hypothermia on drug metabolism (Drs. Poloyac and Empey) and determining the effect of trauma on nutritional requirements (Dr. Rebecca Smith).

Grants Currently Funded

U01 NS052478 – "Pediatric Traumatic Brain Injury Consortium: Hypothermia"; PI: PD Adelson; Site PI: Bell – 2007 - 2012

R01, NINDS/NICHHD – "Overcoming Membrane Transporters to Improve CNS Drug Therapy"; PI: Robert Clark; Clinical PI: Bell - 2009 – 2014.

CDC, RFA - "Overcoming Barriers to Adoption of Pediatric Traumatic Brain Injury Guidelines"; PI: Monica Valvilala, University of Washington, Site PI: Bell – Priority Score 200, Awaiting Council

Grants Submitted with Results Pending

R01, NINDS - "Decreasing Nursing Barriers to Adoption of the Pediatric Brain Injury Guidelines"; PI: Monica Vavilala, University of Washington, Site PI: Bell – Submitted 2/09

R01, NIMH – "Cognitive and Neuroimaging Outcome with Children with TBI: ADHD"; PI: Sue Beers; Co-Investigator: Bell – Resubmitted 6/09

R01, NINDS – "Hypothermia for Inflicted Childhood Brain Injury"; PIs: Berger and Bell – Resubmitted 7/09

Papers Published

Kochanek PM, Fink EL, Bell MJ, Bayir H, Clark RSB. "Therapeutic hypothermia: Applications in pediatric cardiac arrest". *J Neurotrauma* 2009; 26(3):421-7.

Ochalski PG, Okonkwo DO, Bell MJ, Adelson PD. "Reversal of coma with flumazenil in a child following a traumatic brain injury". *J Neurosurg Pediatr* 2009; 3: 240-243.

Bell MJ and Kochanek PM. "Traumatic brain injury in children: Recent advances in management". *Indian J Pediatr* 2008; 75(11): 1159-1165.

Kochanek PM, Bell MJ, Adelson PD. "Critique of Traumatic Brain Injury Trial by Hutchison et. al.". 2008; *N Engl J Med* 359(11):1179.

Adelson PD. "Hypothermia following pediatric traumatic brain injury". *J Neurotrauma* 2009; 26(3):429-36.

Bayir H, Adelson PD, Wisniewski SR, Shore P, Lai Y, Brown D, Janesko-Feldman KL, Kagan VE, Kochanek PM. "Therapeutic hypothermia preserves antioxidant defenses after severe traumatic brain injury in infants and children" *Crit Care Med* 2009; 37: 689-95.

Fink EL, Lai Y, Zhang X, Janesko-Feldman K, Adelson PD, Szabó C, Berger RP, Sarnaik AA, Kochanek PM, Clark RS. "Quantification of poly(ADP-ribose)-modified proteins in cerebrospinal fluid from infants and children after traumatic brain injury". *J Cereb Blood Flow Metab* 2008; 28(9):1523-9.

Presentations at National Meetings

Salonia R, Poloyac S, Ruppel RA, Klamerus M, Feldman K, Adelson PD, Berger RP, Bell MJ, Clark RSB, Bayir H, Fink E, Kochanek PM. "Therapeutic Hypothermia Exacerbates Increases Cerebrospinal Fluid Endothelin-1 Levels in Infants and Children after Severe Traumatic Brain Injury". *J Neurotrauma* 25 (7): 892, 2008.

Stippler M, Adelson PD, Brown SD, Chang Y, Bell MJ. "Measurement of Brain Oxygenation (PbO₂) as part of a Multimodality Monitoring Approach to the Management of Children With Severe Traumatic Brain Injury". *J Neurotrauma* 25 (7): 928, 2008.

Smith R, Lin J, Adelson PD, Brown SD, Wisniewski S, Bayir H, Clark RSB, Kochanek PM, Fink E, Bell MJ. "Effects of Hyperglycemia on Outcome in Severe Traumatic Brain Injury (sTBI) in Children". *J Neurotrauma* 25 (7): 883, 2008.

Empey PE, Poloyac SM, Salonia R, Adelson PD, Brown SD, Kochanek PM, Bell MJ. "A UPLC-MS/MS Method for Determination OF CSF Fentanyl Concentrations in Pediatric TBI Patients Receiving Therapeutic Hypothermia". *Crit Care Med* 36 (12): A128, 2009.

Salonia R, Empey PE, Poloyac SM, Klamerus M, Clark RSB, Brown SD, Adelson PD, Kochanek PM, Bell MJ. "The Effect of Therapeutic Hypothermia on Cerebrospinal Fluid Endothelin-1 in Children after Severe Traumatic Brain Injury". Crit Care Med 36 (12): A121, 2009.

Smith R, Lin J, Adelson PD, Brown SD, Wisniewski S, Bayir H, Clark RSB, Kochanek PM, Fink E, Bell MJ. "Effects of Hyperglycemia and Insulin Administration on Outcome in Severe Traumatic Brain Injury in Children". Crit Care Med 36 (12): A45, 2009.

Salonia R, Miller T, Bell MJ, Kochanek PM, Brown SD, Adelson PD, Poloyac S. "Identification of Arachidonic Acid (AA) Metabolites in Cerebrospinal Fluid of Infants and Children after Traumatic Brain Injury - A Preliminary Report". Crit Care Med 36 (12): A122, 2009.

Salonia R, Berger R, Bell MJ, Kochanek PM. "Near Infrared Spectroscopy (NIRS) to Detect Intracranial Hemorrhage (ICH) after Traumatic Brain Injury (TBI) in Children". Crit Care Med 36 (12): A121, 2009.

Sanchez de Toledo J, Adelson PD, Watson RS, Gaines B, Brown SD, Kochanek PM, Clark RSB, Bell MJ. "Relationship Between Pancreatitis and Cerebral Events in Children after Traumatic Brain Injury". Crit Care Med 36 (12): A121, 2009.

Au AK, Carcillo JA, Clark RSB, Bell MJ. "Brain Injury Contributes to Greater than 90% of Deaths in Previously Healthy Children in the PICU". Crit Care Med 36 (12): A128, 2009.

Smith CM, Adelson PD, Chang Y-F, Brown SD, Kochanek PM, Clark RSB, Bayir H, Hirschberger J, Bell MJ. "Brain-Systemic Temperature Gradient is Temperature-Dependent in Children with Severe Traumatic Brain Injury". Crit Care Med 36 (12): A124, 2009.

Ortiz V, Adelson PD, Chang Y-F, Brown SD, Kochanek PM, Clark RSB, Bayir H, Bell MJ. "Brain Temperature Effects on PbO₂ in Children after Traumatic Brain Injury are not Clinically-Significant". Crit Care Med 36 (12): A12, 2009.

Advocacy Summary

Recently, a Community Advisory Board for the PNTC has been organized. It is expected that this group will advise the PNTC as well as CHP administration on any and all aspects of the care of children after traumatic brain injury, including acute care and rehabilitative aspects. Paul Polinko, Pastor Richard Freeman and Mr. Napodano (parent) have agreed to organize the group and will work on more precisely defining the structure of the Board and its mission. We anticipate that this new effort will give the PNTC a fresh perspective on our strengths and weaknesses. We further expect that this group will serve as a springboard for advocacy of victims of trauma within the region and across the country.

Members of the PNTC have also joined the Sarah Jane Foundation, an effort started by Patrick Donohue in New York to advocate for funding for children with inflicted traumatic

brain injury and other acquired brain disorders. Rachel Berger is leading the effort at the University of Pittsburgh and we have been named the Pennsylvania Lead Center for the Pediatric Acute Brain Injury Plan (PABI). We look forward to working with this national organization in increasing awareness of brain injuries in children across the US and in our community.

Lastly, a philanthropic donor was identified during the transition to the new hospital by Rebecca Smith and others working for the PNTC. Efforts are being coordinated with the hospital's infrastructure to obtain funding for needed equipment for children with trauma, including a portable CT scanner, bedside neurological monitoring equipment, equipment for clinical research and other needed supplies.