PEDIATRIC REVIEW

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Explaining Traumatic Brain Injury and Recovery to Parents

*By **Nadia Webb**, Psy. D., pediatric neuropsychologist at Children's Hospital. This issue of Pediatric Review is intended for pediatricians, family physicians and all other interested medical professionals. For CME purposes, the author has no relevant financial relationships to disclose.*

OBJECTIVES

At the end of this activity, the participant should be able to:

1. explain how traumatic brain injuries occur
2. describe the brain's physical reaction to injury
3. discuss how pediatricians and care-givers may treat traumatic brain injuries

INTRODUCTION

Traumatic brain injuries (TBI) are caused by rapid changes in velocity, such as those caused by a fall or the impact of car on a pedestrian, bicycle or car. TBI can occur without a direct blow to the head since the base of the skull is jagged and the soft tissue of the brain is abraded as it slides across bone. The brain may bruise as the head whips forward and back, first bruising against the front of the caldera (coup) and then bruise again when it ricochets against the back surface (contre coup).

THE PHYSICS OF BRAIN INJURIES

The physics of brain injuries are easily explained using the following analogies: the game of pool, a record player, spaghetti, and a soda bottle.

A motor vehicle accident is easily explained to parents using the analogy of the game of pool, and picturing the force vector as the pool cue knocks one ball against another.

The first force is translation. If the cue and two balls were perfectly in line, the force of the cue hitting the first ball would knock the second ball forward in a straight line. The second ball is then similar to a car being rear-ended during a collision. But the world is rarely so tidy. Cars, like pool balls, are usually hit at angles, which produces spin or rotation.

Rotation adds a whole new set of forces that are inflicted upon the brain. In addition to the direct translational force of the impact, rotation spins the brain inside the skull as well as the car. Now centrifugal force comes into play, as does the metaphor of the record player. The faster, more violent or lengthier the spin, the more likely brain tissue will begin to fragment or tear apart. Imagine a record player with a Styrofoam cup of coffee sitting on a spinning record. If the speed is slow and the cup is near the center, it will remain stable. However, if you move the cup toward the edge and speed up the record, the coffee cup goes flying across the room. As the brain spins, the neurons are now travelling at different speeds in different parts of the brain and the brain tissue "wants" to fly apart. Typically, it begins to tear at the junctions of gray and white matter or at the flexion point of the brain (basal ganglia) because the tissue is of different densities. These typically stop, start and rotate at slightly different speeds.

In imagining neuronal injury, the metaphor of spaghetti comes into play. Individual neurons have the texture of overcooked spaghetti and may be compressed, stretched and rotated during the accident, producing diffuse injury. Their protective fatty sheaths of myelin may become torn, and some neurons may be damaged beyond repair (called diffuse axonal injury or DAI). Neurons with longer axons are more vulnerable. These are typically neurons relaying signals that integrate information from different regions of the brain. Certain structures that are tethered are also more vulnerable, such as an olfactory neuron travelling through the cribiform plate or the infundibular stalk tethering the brain and the pituitary. Unsurprisingly, there is a higher incidence and prevalence of

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endocrine disorders in this population.

Perhaps the most difficult concept to explain is cavitation. Comparisons between the brain and a soda bottle may help to explain this concept. The main component of the brain is water. As a shock wave travels through water it creates turbulence, much as the churning of air behind a plane or water behind a boat. As the brain hurtles forward during a rear end collision, it creates an area of low pressure (or vacuum) behind it. This produces an empty place where the brain was just a split second earlier. What follows is a brief period of cavitation, in which the force of the collision turns the liquid components of the brain into gas and bubbles grow and collapse. It is similar to the carbonation in a soda bottle, which is calm and still when under pressure. It is the release of the carbonation into the relative vacuum of room air that causes all of the tumult. "Carbonating" the brain is the highly destructive mechanism behind blast injuries. As any veteran with a brain injury secondary to an Improvised Explosive Device explosion can testify, a brain injury doesn't require that you "hit your head."

Explaining Recovery

Most parents hear about brain injury in fiction, a process that typically involves waking suddenly from a coma with no ill effect. This erroneous understanding of the process of recovery leaves parents unprepared for the possibility of a brain injury as a chronic condition. The coverage of Congresswoman Gabrielle Gifford's recovery from a point-blank shot to the brain has provided a more realistic picture of the length and complexity of TBI. Gifford's five months of inpatient neurorehabilitation treatment is typically unavailable to families who cannot pay out of pocket. Currently, Gifford remains aphasic, and is attending an intensive outpatient program several hundred miles from her home.

In addition to the duration and intensity of her care, Congresswoman Gifford has several personal qualities that predict a better outcome from her injury. One powerful protective factor includes exceptional neurocognitive functioning prior to the injury. High levels of intelligence and education are both known to increase reserve capacity. Just as in baseball, a brain can have a "deep bench." The healthier the brain and the greater the connectivity between neurons prior to a brain injury, the more likely it is that other linked neurons can take over the task of an injured "team mate." Risk factors for poor outcomes include prior neurocognitive insults (such as significant concussions), developmental disorders, mental illness, poor quality of diet, other chronic health conditions such as diabetes or sickle cell anemia, the presence of alcohol during the injury and secondary injuries such as hypoxia.

Recovery involves metabolic and structural repairs. Structurally, the brain begins repairing those neurons that are viable and re-routing around the glial scarring left behind when brain tissue has died. Much of the repair is a slow process of "road construction" in a hostile environment. The hostility of the extracellular environment is produced by cells that scavenge damaged tissue before it can be repaired and chemical changes that interfere with recovery (e.g., the presence of myelin associated inhibitors, the absence of laminins and decreased expression of nerve growth factors).

Brain injury is associated with metabolic alterations, some of which persist for at least a year after the event. The brain is already a "heavy fuel user," but it develops greater metabolic demands during recovery, both due to repair and because of greater inefficiencies performing tasks after the injury.

TBI Risk for Children

Children appear to be at greater risk for poor outcome than adults for physiologic and developmental reasons. For example, children show higher rates of neurodegeneration after trauma (Bittigau et al., 1999). As developing organisms, their recovery is also more difficult. Children are at the relative beginning of their development socially, academically and physically. The extra challenge they face is to learn to master their environment with an injured brain rather than to reconsolidate skills already established when the child was neurologically intact. The full extent of their injuries may not be apparent until neurocognitive skills fail to appear later. As aptly described by one of the directors of the Children's Hospital Neurorehabilitation Center, children are like a mansion with many rooms. You walk through the house checking the wiring by flipping the light switch in each room. Thus, you won't know if the wiring is working in a particular room until you get there.

Children are dependent on the quality of care in their support networks and their injuries are particularly jarring to families. The frontal lobes are acutely vulnerable to injury because of the structure of the caldera, putting the most evolutionarily recent parts of the brain in direct jeopardy. Brain injury tends to alter personality, emotional self-control, planning, judgment, self-awareness, social perceptiveness, attention and the ability to delay gratification. Loss of these abilities tends to foster obnoxious, shortsighted, immature behavior. All children with disabilities are at greater risk for abuse and maltreatment, however the intersection of the stresses of caring for a disabled child and the potential for personality change can be a perfect storm if families feel unsupported or are uninformed. In addition to the usual pragmatic consequences to families caring for a chronically ill child, these children are uniquely challenging.

Treating TBIs

Pharmacologically, the better researched options to enhance recovery include Namenda, the selective serotonin reuptake inhibitors (SSRIs) such as Prozac, the stimulants, and Amantadine. Namenda appears to produce a neuropro-

tective effect during the first 24 hours post-injury, however there is literature indicating lasting neuroprotection against oxidative stress secondary to the persistent, excessive metabolic demands. Namenda also shows precognitive effects by modulating NMDA channel activity during such periods of excessive glutamatergic output. The SSRI's putative effect is through the enhancement of brain derived neurotrophic factor, which enhances neuronal arborization. A study of stroke survivors, for example, indicates greater recovery on motor tasks for patients prescribed an SSRI. Amantadine may produce gains through novel mechanisms, but has pro-attentive properties, may decrease vulnerability to some opportunistic viral infections and reduce Parkinsonian symptoms such as amotivation, flat affect, bradykinesia and poor initiation.

Pediatricians may prescribe SSRIs, as Namenda and Amantadine are within the common formulary. They can also prescribe the ADHD medications, such as stimulants, alpha adrenergic agonists (Intuniv, Guanfacine) or Provigil for children with post-TBI attention and executive functioning deficits.

Concussions are brain injuries. They are simply subtle enough that the child can compensate for them under normal circumstance. Recent changes in Louisiana law are mandating greater oversight for return to play decisions since the effect of cumulative concussions is synergistic rather than simply additive.

In general, the role of a pediatrician will be to help children and parents take the long view and appreciate that delaying return to play and a few missed games is worth it. High school and college athletes are likely to minimize and deny concussions rather than over-report them. The research literature indicates that student athletes are more likely to report a concussion after the season ends when they are no longer worried about being kept out of the game. The rule of thumb is that a student athlete has experienced three concussions during a season for every one that is identified or reported.

Resources for Families

Local

Brain Injury Association of Louisiana: BIALA.org
Families Helping Families *(Statewide chapters)*

Web-Based

Brain Injury Association of America: BIAUSA.org
American Aphasia Society: Aphasia.org
Paralyzed Veterans of America: pva.org
Provides free literature on neurogenic bladder and bowel, sexual functioning, etc.
Mood-Gym (Online, free Cognitive Behavioral Therapy): moodgym.anu.edu.au/

References

1. Bittigau P, Sifringer M, Pohl D, Stadthaus D, Ishimaru M, Shimizu H, Ikeda M, Lang D, Speer A, Olney JW, Ikonomidou C. Apoptotic neurodegeneration following trauma is markedly enhanced in the immature brain. Ann. Neurol. 1999; 45:724–735

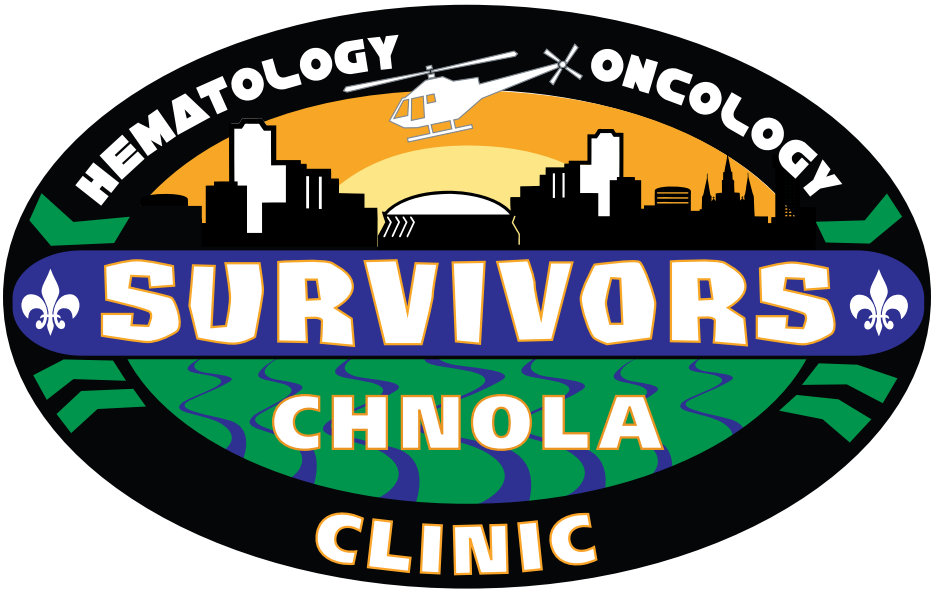
2. Robertson, CL, Scafidi, S, McKenna, MC, Fiskum, G. Mitochondrial mechanisms of cell death and neuroprotection in pediatric ischemic and traumatic brain injury. Experimental Neurology. Volume 218, Issue 2, August 2009, Pages 371-380

3. Free online reprint of this review – covers many of the hypothetical interventions post-TBI: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3096876/?tool=pubmed

Medical Staff Notes

Seth Pincus, MD, director of The Research Institute at Children's Hospital, received a $100,000 grant from the Bill and Melinda Gates Foundation. Dr. Pincus' research lab in New Orleans will create antibodies which could wipe out a hard-to-eradicate reservoir of HIV cells in people infected with the AIDS virus. He is the only Louisiana or Mississippi researcher among more than 100 scientists getting one of the latest round of "Grand Challenge Exploration" grants.

Martin Drell, MD, was installed to a 2-year term as president of the American Academy of Child and Adolescent Psychiatry at the AACAP's annual meeting in Toronto. The AACAP has nearly 9,000 members.



Children's Hospital opens Treatment After Cancer and Late Effects Survivorship Clinic

In the past 40 years, medicine has made major advancements in the fight against pediatric cancer. A child diagnosed with cancer in 1970 had only a 10 percent chance of survival, whereas children diagnosed today have a nearly 80 percent chance. But for the more than 40,000 children who undergo treatment each year, their struggle does not end when their disease is eradicated. Three out of five who survive children's cancer suffer late-developing side effects as a result of their disease, its treatment, or both, which may include long-term medical, psychosocial and/or neurocognitive problems. To help the growing number of Gulf South children who are beating cancer yet facing potential treatment-related problems, Children's Hospital opened a Treatment After Cancer and Late Effects Survivorship Clinic.

"It has just been in the past few years, as pediatric cancer survival rates have increased, that the medical community has recognized and reacted to the need for long-term, comprehensive care, education, counseling and support," said Lolie Yu, MD, chief of Hematology/Oncology, professor of pediatrics and director of the Bone Marrow Transplant Program at LSU Health Sciences Center & Children's Hospital. "We treat more Louisiana children with cancer than all other facilities combined, so this addition will have a far-reaching impact on the quality of life for the kids of our region."

The clinic offers a comprehensive follow-up program to help childhood cancer survivors stay well. Through case-specific diagnostic tests and evaluations, Children's healthcare professionals will be able to help patient families identify, understand, prevent and treat many of the maladies cancer survivors endure, including:

- Heart problems, including an increased risk of heart arrhythmias
- Blood vessel problems, including an increased risk of stroke or clots
- Lung problems, which can cause difficulty breathing
- Liver problems
- Kidney problems
- Dental problems
- Glandular problems such as thyroid problems
- Bone problems, such as bone thinning (osteoporosis) and joint pain
- Short stature, caused by slow bone growth or growth hormone deficiency
- Obesity
- Reproductive health problems and infertility
- Memory problems and learning disabilities
- Psychological problems
- Vision loss
- Hearing loss
- Increased risk of other types of cancers
- Chronic pain

Pinki Prasad, MD

"Cancer treatments are given when young bodies are growing and minds are developing," said Pinki Prasad, MD, an expert in late effects and survivorship who was recruited by Children's Hospital to join the Hematology/Oncology Department and oversee the clinic. "Some cancer survivors develop no late effects from treatment, while others have mild, moderate, or severe late effects that may show up immediately or decades later."

Most cancer survivors will begin using the clinic five years after their treatment ends. Nurse manager Lynn Winfield is coordinating which patients will be in clinic each day. Instead of focusing on the chance of a relapse, the late effects clinic will help with comprehensive healthcare planning and early detection and treatment of late effects, Prasad said. In addition, the team can advocate for survivors at schools, insurance agencies and employers, when necessary.

This fall, Children's Hospital received a $100,000 Hope Grant from the Hyundai Hope on Wheels program to launch the late effects clinic. The program supports "the best, brightest and most promising researchers, whose work is likely to have a significant impact on understanding the biology and/or developing diagnostic and therapeutic approaches in the field of pediatric cancer." Hyundai awarded $7.1 million this year to 71 pediatric cancer research projects and programs at Children's Oncology Group (COG) institutions across the country. Since 1998, Hyundai Hope on Wheels and its more than 800 dealers have been committed to fighting childhood cancer and raising awareness to finding a cure.

"At Hyundai, we thrive on new thinking and new possibilities, and Hope on Wheels supports doctors and hospitals doing just that — creating new possibilities that could someday cure childhood cancer," John Krafcik, president and CEO of Hyundai Motor America, said via press release. "We're proud that for 13 years, Hyundai and its dealers will have donated more than $34 million to the cause. Our goal is to support the important research that will find a cure for pediatric cancer."

Late Side Effects of Cancer Treatment

Three out of five who survive pediatric cancer suffer late effects, which may include long-term medical, psychosocial, and/or neurocognitive problems as a side effect of their disease, its treatment, or both. Listed are common late side effects from cancer therapies and treatments.

Treatment	Late Effects
Chemotherapy	Cataracts, early menopause, heart problems, infertility, liver problems, lung disease, osteoporosis, reduced lung capacity, increased risk of other cancers
Radiation therapy	Cataracts, cavities and tooth decay, heart problems, hypothyroidism, infertility, lung disease, intestinal problems, memory problems, osteoporosis, increased risk of other cancers
Surgery	Lymphedema

Children's Hospital Specialty Clinics & Therapies

CLINICS IN NEW ORLEANS, METAIRIE, BATON ROUGE AND LAFAYETTE

Allergy/Immunology
Dimitriades, Victoria [M, BR] ..... (504) 896-9589
Ochoa, Augusto [M, L] ..... (504) 896-9589
Paris, Ken [M, L] ..... (504) 896-9589
Sorensen, Ricardo [M] ..... (504) 896-9589

Amputee Clinic
Gonzales, Tony ..... (504) 896-9569

Cardiology
Ascuitto, Robert [BR] ..... (504) 896-9751
Gajewski, Kelly ..... (504) 896-9751
Lilje, Christian ..... (504) 896-9751
Ross-Ascuitto, Nancy [BR] ..... (504) 896-9751
Sernich, Steffan ..... (504) 896-9751
Siwik, Ernest ..... (504) 896-9571
Stopa, Aluizio ..... (504) 896-9571

Cardiothoracic Surgery
Caspi, Joseph ..... (504) 896-3928
Dorotan, Jaime ..... (504) 896-3928
Pettitt, Timothy ..... (504) 896-3928

Children at Risk Evaluation (CARE) Center
Jackson, Jamie ..... (504) 896-9237
Wetsman, Ellie [BR] ..... (504) 896-9237

Cleft/Craniofacial
Moses, Michael ..... (504) 896-9857
St. Hilaire, Hugo ..... (504) 896-9857

Clinical Trials ..... (504) 894-5377

Cochlear Implants
Arriaga, Moises ..... (504) 896-2141
Marks, Herbert ..... (504) 896-2141

Craniofacial/Genetics
Lacassie, Yves [M] ..... (504) 896-9857
Marble, Michael ..... (504) 896-9857
Zambrano, Regina ..... (504) 896-9857

Cystic Fibrosis
Levine, Stephen ..... (504) 896-9436
Pepiak, Derek ..... (504) 896-9436

Dental
Mobile Dental Program 34-BRUSH
Ritwik, Priyanshi ..... (504) 896-9580

Dermatology
Poole, Jeffrey ..... (504) 896-9532

Developmental/High Risk
Wong, Joaquin ..... (504) 896-9458

Diabetes
Chalew, Stuart ..... (504) 896-9441
Gomez, Ricardo ..... (504) 896-9441
Stender, Sara ..... (504) 896-9441
Vargas, Alfonso [M] ..... (504) 896-9441

Down Syndrome
Lacassie, Yves [M] ..... (504) 896-9254
Marble, Michael ..... (504) 896-9254
Zambrano, Regina ..... (504) 896-9572

Endocrinology
Chalew, Stuart ..... (504) 896-9441
Gomez, Ricardo [M, BR] ..... (504) 896-9441
Stender, Sara ..... (504) 896-9441
Vargas, Alonso [M, BR] ..... (504) 896-9441

Epilepsy Surgery
McGuire, Shannon ..... (504) 896-9458

Feeding Clinic
Hyman, Paul ..... (504) 896-9534

Gastroenterology
Brown, Raynorda [M, BR] ..... (504) 896-9534
Hyman, Paul ..... (504) 896-9534
Keith, Brent ..... (504) 896-9534
Monagas, Javier [M] ..... (504) 896-9534
Noel, Adam [M] ..... (504) 896-9534
Rosenberg, Allan [M, BR] ..... (504) 896-9534

Genetics
Lacassie, Yves [M, BR] ..... (504) 896-9254
Marble, Michael [BR, L] ..... (504) 896-9572
Zambrano, Regina [M, BR] ..... (504) 896-9572

Gynecology
Wells, Lindsay ..... (504) 896-2888

Hematology/Oncology
Gardner, Renee ..... (504) 896-9740
Morales, Jaime [BR, L] ..... (504) 896-9740
Morrison, Cori ..... (504) 896-9740
Prasad, Pinki ..... (504) 896-9740
Velez, Maria [BR] ..... (504) 896-9740
Yu, Lolie [L] ..... (504) 896-9740

Hemophilia Clinic ..... (504) 896-9740

HIV Clinic/FACES
Wilcox, Ronald ..... (504) 896-9583

Hospitalists
Referrals ..... (504) 896-3924
English, Robin ..... (504) 896-3924
Hauser, Andrea ..... (504) 896-3924
Hescock, Jay ..... (504) 896-3924
Roy, Melissa ..... (504) 896-3924
Sulton-Villavasso, Carmen ..... (504) 896-3924

Infectious Disease
Bégué, Rodolfo ..... (504) 896-9583
Wilcox, Ronald ..... (504) 896-9583

International Adoption Clinic
Bégué, Rodolfo ..... (504) 896-9583

Kidney Transplant
Buell, Joseph ..... (504) 896-9238
Killackey, Mary ..... (504) 896-9238
Paramesh, Anil ..... (504) 896-9238
Slakey, Douglas ..... (504) 896-9238

Kidney Transplant Clinic
Vehaskari, Matti ..... (504) 896-9238

Metabolic
Marble, Michael ..... (504) 896-9254

Muscular Dystrophy
Tilton, Ann ..... (504) 896-9283
Weimer, Maria ..... (504) 896-9283
Wong, Joaquin ..... (504) 896-9283

Nephrology
Aviles, Diego [BR, L] ..... (504) 896-9238
Bamgbola, Oluwatoyin [BR, L] ..... (504) 896-9238
Iorember, Franca ..... (504) 896-9238
Straatman, Caroline ..... (504) 896-9238
Vehaskari, Matti [L] ..... (504) 896-9238

Neurofibromatosis
Lacassie, Yves ..... (504) 896-9254
Marble, Michael ..... (504) 896-9254
Zambrano, Regina ..... (504) 896-9572

Neurology
Conravey, Allison [M] ..... (504) 896-9458
Deputy, Stephen ..... (504) 896-9458
MGuire, Shannon ..... (504) 896-9458
Tilton, Ann ..... (504) 896-9283
Weimer, Maria ..... (504) 896-9859
Wong, Joaquin ..... (504) 896-9458

Neuromuscular
Gonzales, Tony ..... (504) 896-9569
Levine, Stephen ..... (504) 896-9436
Tilton, Ann ..... (504) 896-9319
Weimer, Maria ..... (504) 896-9859
Wong, Joaquin ..... (504) 896-9283

Neurosurgery
Greene, Clarence ..... (504) 896-9568
McBride, Lori ..... (504) 896-9568
Nadell, Joseph [L] ..... (504) 896-9568

Occupational Therapy (504) 896-9540

Ophthalmology
Ellis, George, Jr. [M] ..... (504) 896-9426
Eustis, Sprague ..... (504) 896-9426
Leon, Alejandro [M] ..... (504) 896-9426
Vives, Tere [M] ..... (504) 896-2134

Orthopaedics
Accousti, William [M, L] ..... (504) 896-9569
Chavez, Manuel, PA ..... (504) 896-9569
Faust, Donald ..... (504) 896-9532
Gonzales, Tony [BR, L] ..... (504) 896-9569
Heinrich, Stephen ..... (504) 896-9569
King, Andrew ..... (504) 896-9569
Lago, Theresa, PA [M] ..... (504) 896-9569
Patel, Prerana ..... (504) 896-9569
Vu, Hung, PA ..... (504) 896-9569

Otolaryngology (ENT)
Arriaga, Moises ..... (504) 896-9572
Hagmann, Michael [M] ..... (504) 896-9532
Kluka, Evelyn [M] ..... (504) 896-9532
Marks, Herbert ..... (504) 896-9572
Simon, Lawrence [BR] ..... (504) 896-9832

Physical Therapy ..... (504) 896-9557

Plastic Surgery
Chiu, Ernest ..... (504) 896-2838
Moses, Michael ..... (504) 896-9857
St. Hilaire, Hugo ..... (504) 896-9857

Psychology
Courtney, John ..... (504) 896-9484
Franz, Diane ..... (504) 896-9484
Gentile, Steven ..... (504) 896-9484
Henke, Amy ..... (504) 896-9484
Heslet, Lynette ..... (504) 896-9484
Jackson, David ..... (504) 896-9484
Kamps, Jodi ..... (504) 896-9484
Webb, Nadia ..... (504) 896-9484

Pulmonology
Edell, Dean ..... (504) 896-9436
Levine, Stephen ..... (504) 896-9438
Pepiak, Derek ..... (504) 896-9438

Rheumatology
Gedalia, Abraham [M, BR, L] ..... (504) 896-9385

Scoliosis/Pediatric Spine
Accousti, William [M] ..... (504) 896-9569
Gonzales, Tony ..... (504) 896-9569
King, Andrew ..... (504) 896-9569

Spasticity
Nadell, Joseph ..... (504) 896-9568
Tilton, Ann ..... (504) 896-9283

Speech & Hearing (504) 896-9551

Surgery
Hill, Charles ..... (504) 896-3977
Steiner, Rodney ..... (504) 896-9756
Valerie, Evans ..... (504) 896-9756

Travel Clinic
Bégué, Rodolfo ..... (504) 896-9583
Wilcox, Ronald ..... (504) 896-9583

Urology
Eeg, Kurt [L] ..... (504) 896-9233
Lee, Raven, PA ..... (504) 896-9233
Ortenberg, Joseph [BR, L] ..... (504) 896-9233
Roth, Christopher ..... (504) 896-9233

Vascular Anomalies
Chiu, Ernest ..... (504) 896-2838
Poole, Jeffrey ..... (504) 896-2838
Simon, Lawrence ..... (504) 896-2838

Wound Clinic
Valerie, Evans ..... (504) 896-9756

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Children's Hospital	**(504) 899-9511**
Ambulatory Care Center	**(504) 896-9532**
The Metairie Center [M]	**(504) 832-4033**
Baton Rouge Center [BR]	**(225) 216-3047**
Lafayette Center [L]	**(337) 289-8289**

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You must complete the following evaluation in order to receive your CME credit.

I enhanced my knowledge of the topic:

Very much				Very little
5	4	3	2	1

The author met the stated objectives:

Greatly				Not at all
5	4	3	2	1

The overall evaluation of the article:

Excellent				Poor
5	4	3	2	1

Did you receive any commercial bias in the material presented in this activity?

☐ Yes ☐ No

How long did it take to read the issue and complete the quiz:

30 minutes 1 hour

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Mailing address: _____

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Topics that you would like to see in future issues: _____

_____

_____

CME Offerings

Pediatric Grand Rounds
1st, 3rd and 5th Wednesday
of each month, 8 – 9 a.m.
Children's Hospital Auditorium

Child Neurology Case Conference
1st, 2nd and 4th Wednesday
of each month, 2 – 3 p.m.
ACC Room 3302

Tumor Board
Wednesdays, 4 – 5 p.m.
Children's Hospital Auditorium

Weekly Pathology Conference
Thursdays, 8 – 9 a.m.
Research Center, Room 4222

Neonatology Conference
Thursdays, 12:30 – 1:30 p.m.
NICU Conference Room

Cath Conference
Fridays, 8 – 9 a.m.
ACC Room 3302

Please call the CME office
at (504) 896-9264
for more information.

Please record your responses to the questions on the form below. Please circle the best possible answer.
CME offer is good through March 2012.

1. The simple physical forces involved in a motor-vehicle-accident induced brain injury usually include:
   a. Translation, rotation, shearing and cavitation
   b. Impact, translation, cavitation and shearing
   c. Cavitation only occurs during blast injuries, so translation, shearing and rotation
   d. Impact of the head against a hard surface is essential for brain injury, so impact, shearing and rotation

2. Risk and protective factors associated with outcomes post-TBI include:
   a. Duration and intensity of services.
   b. Premorbid neurocognitive status
   c. Social and familial support
   d. B & C only
   e. All of the above

3. The concept of reserve capacity means:
   a. Executive functioning allows for greater "top down" capacity to find alternate approaches to compensate for injury
   b. Individuals with higher cognitive functioning typically have a better prognosis
   c. Attention serves as a cognitive reserve. Failures of attention undermine virtually all forms of cognitive functioning.
   d. Protecting the patient from frivolous decision making and minor frustrations buffers them from fatigue and allows for a cognitive reserve during more critical tasks.

4. The consequences of a brain injury may not be evident for years?
   a. This is true for children under the age of 3
   b. This is true for all children.
   c. This is false. Brain injury only occurs if a child is immediately symptomatic and those same symptoms persist.
   d. This is categorically false.

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