Medical Treatment In Brain Injury

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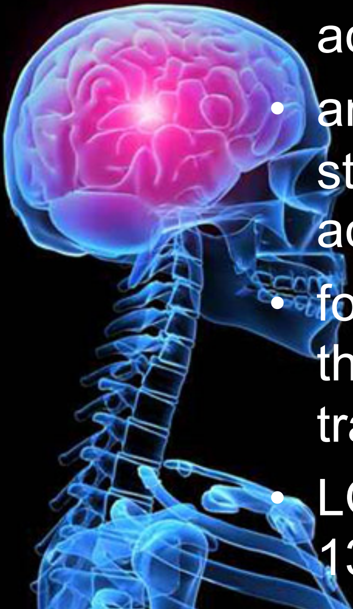
OK to KEEP PHONES OUT

- TEXT "CHRISTOPHERW722" (all caps) now to 37607 to join the surveys to be used throughout. Only have to do this once then you can answer

TBI

- Mild TBI1993
  - American Congress of Rehabilitation Medicine defined mild head injury as:
    - any period of loss of consciousness
    - any loss of memory for events immediately before or after the accident
    - any alteration in mental state at the time of the accident
    - focal neurological deficits that may or may not be transient
    - LOC <30min, GCS 13-15, PTA <24hours



Epidemiology

- Traumatic brain injury in the United States: Emergency department visits, hospitalizations and deaths 2002-2006. Atlanta, GA: Center for Disease Control and Prevention; 2006.
  - 1.7 million present to ER with TBI
  - 1.4 million (80%) discharged same day
  - Estimated 1.4-3.8 million concussions per year in U.S.

1. Falls
2. MVC

Primary Brain Injury

- Primary Injury
  - Contusions & lacerations
  - Traumatic axonal injury/Diffuse axonal injury
    - Typically thought due to shear forces
  - Diffuse vascular injury
  - Cranial nerve injury

Traumatic Axonal Injury

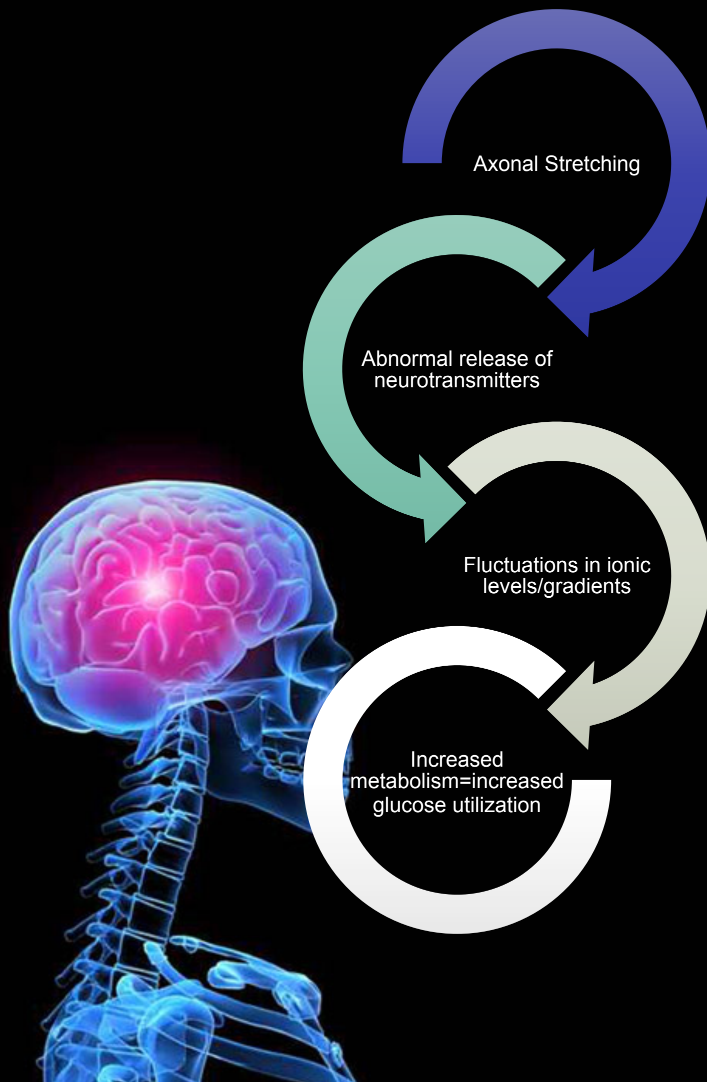
- Responsible for initial loss of consciousness seen in acute TBI
- Results from acceleration-deceleration and rotational forces associated with high-velocity impact
- Typically occur at Grey-White matter junction in frontal & temporal lobes and in more severe injuries in corpus callosum & brainstem
- Not consistently seen on CT and may be missed or not well visualized on MRI

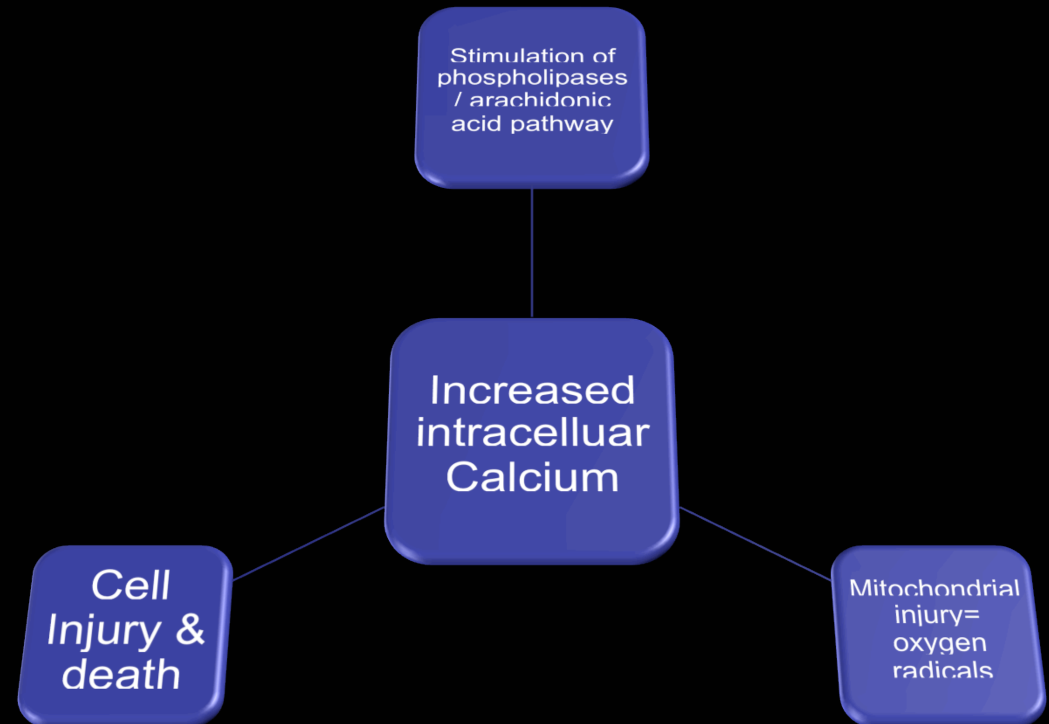
Secondary Injury

- Intracranial factors
  - ICH
  - Edema/swelling
  - Infection
  - Hydrocephalus
  - Free-radical damage
  - Increased release of excitatory neurotransmitters (glutamate)
  - Necrosis to apoptosis of cells

- Extracranial factors
  - Hypoxia
  - Hypotension
  - Vascular injury
  - Electrolyte abnormalities
  - Anemia
  - Hyperthermia
  - Hypercarbia
  - Hypoglycemia
  - Seizures

Pathophysiology





Zasler ND, Katz DI, Zafonte RD, eds. Brain Injury Medicine: Principles and Practice. Ch. 24 “Sport-Related Concussion”. Collins MW, Iverson GL, Gaetz M, Lovell MR

Timing of Molecular Events

0 min-1 hour	1-~5hours	6-24 hours	1-15 days
Ion channel changes	NO generation	Inflammation	Free radicals
Glycine	Inflammation	Free radicals	Protease activity
Glutamate			Growth factor expression
NMDA/GABA			

Blast Injury

- Primary
  - Rapid shift in air pressure
- Secondary
  - Impacts with objects propelled during explosion
- Tertiary
  - Injury from being thrown into object

Acute Management for Mod/Sev TBI

- Early involvement of entire team including Trauma, Neurosurgery, Medicine, PM&R, Social Services, PT, OT, ST, Nutrition, Psychology
- Glasgow Coma Scale
  - Scores 3-15
  - Severity of TBI
    - 3-8 severe injury
    - 9-12 moderate injury
    - 13-15 mild injury

Medical Complications after TBI

- Posttraumatic Hydrocephalus
- Posttraumatic Headache
- Posttraumatic Seizures
- Autonomic Storming
- Hypertension
- DVT
- Heterotopic Ossification
- Endocrine abnormalities
- Pscyhiatric/Psychologic
- Cognitive/Memory impairment
- Fatigue

“Missed” Complications

- Cranial neuropathies
- Peripheral nerve injuries
- Occult fractures
- Spinal cord injuries
- Urinary dysfunction
- Neurogenic bowel
- Psychologic/Cognitive

Other Problems Arising After TBI

- Spasticity
- Sleep disturbance
- Sexual dysfunction
- Movement disorders
- Dysphagia/Nutrition

Functional Impairments

- ADL's
- Mobility issues
- Sleep-wake cycle disruption
- Anger/personality change
- Anxiety/Depression type symptoms
- Irritability
- Impulsivity
- Frustration

- Memory impairments
- Hearing impairment/ tinnitus
- Fatigue
- Communication issues
- Balance Impairment
- Dizziness (BPPV)
- Headaches

Rehabilitation

- Evidence mounting supporting early application of rehabilitation strategies to shorten length of hospitalization and enhance quality of outcome
    - Tukstra LS, Holland AL, Boys, GA. The neuroscience of recovery and rehabilitation: What have we learned from animal research. *Arch Phys Med Rehabil* 2003; 84:604-12
    - Cowan TD, Meythaler JM, et al. Influence of early variables in traumatic brain injury on functional independence measure scores and rehabilitation length of stay and charges. *Arch Phys Med Rehabil.* 1995;76:797-800
    - Sirios MJ, Lavoie A, Dionne CE. Impact of transfer delay to rehabilitation in patients with severe trauma. *Arch Phys Med Rehabil.* 2004;85:184-91
    - Wagner AK, Zafonte RD, Goldberg G, et al. Physical Medicine and rehabilitation consultation: Relationships with acute functional outcome, length of stay, and discharge planning after traumatic brain injury. *Am J Phys Med Rehabil* 2003; 82:526-36
- Physiatric Assessment
    - Assess residual impairments
    - Estimation of prognosis
    - Initiation of early rehab interventions emphasizing preparation for ongoing rehab needs and preventing complications
    - Formulation of long term plans to address rehab needs and reintegration of survivor into society roles, family roles, life roles

Injury

Emergency medical services

Acute hospital care

Acute inpatient rehabilitation

Subacute and skilled nursing facility care

Residential rehabilitation

Outpatient rehabilitation:
Individual therapy
Day program
Home program

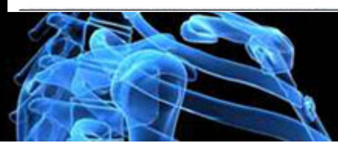
Vocational services

Special education

Community-based services:
Supported living
Support networks
Support groups
Recreation groups

Home

FIGURE 1-1



Pharmacotherapy

- Consider only if:
  - Symptoms beyond typical recovery time
  - Symptoms negatively effecting quality of life
  - Experience in treating

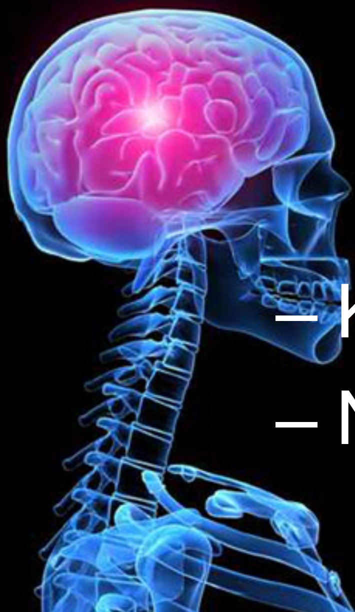
Considerations before Pharmacologic Intervention

- Environment
- Pain
- Sleep/wake
- “Bad meds”

What are the "bad meds?"

- Worsened Behavior
  - Benzodiazepines
  - Dopamine active medications
    - Amantadine, metoclopramide, levodopa
  - Keppra
  - Narcotics

- Impaired consciousness/ cognition
  - Antihistamines
  - Narcotics
  - Benzodiazepines
  - Non-selective beta blockers
  - Anti-epileptic medications
  - Anti-psychotic
  - Baclofen/tizanidine/ cyclobenzaprine



General Principles

1. Start low, go slow
2. Adequate therapeutic trial of a medication
3. Augment rather than max out
4. Polypharmacy warning!
5. Fluid process

Problems to address

- Agitation/Aggression
- Irritability
- Anxiety
- Mood disturbance
- Depression
- Psychosis
- Pseudobulbar affect
- Arousal/alertness
- Attention difficulties
- Memory Impairment
- Cognition

Ranchos Los Amigos Scale

- I= No Response
- II= Generalized Response to Stimuli
- III= Localized Response to Stimuli (Total Assist)
- IV= Confused/Agitated (PTA, Max A)
- V= Confused/Inappropriate (distractible, Max A)
- VI= Confused/Appropriate (mod A)
- VII= Automatic/appropriate (min A)
- VIII= Purposeful/Appropriate (SBA)
- IX= Purposeful/Appropriate (SBA on request)
- X= Purposeful/Appropriate (mod I)

Agitation/Aggression/Anxiety

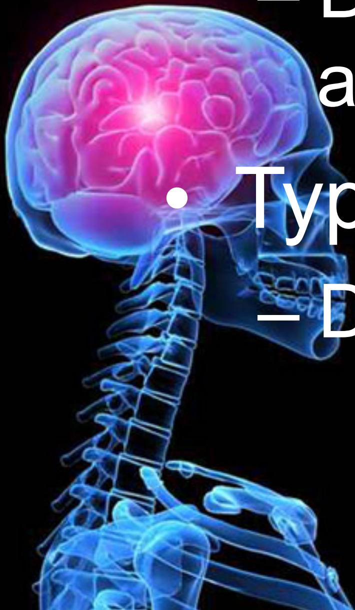
- Violent aggressive
- Aggressive Agitated
- Agitated-Confused
- Motor-restless
- Anxiety

Restraint Considerations

- Environmental
  - Reduce level of stimulation
  - Protect patient and others
  - Tolerate some restlessness if safe
- Soft Restraints
- Alarms
- 1:1 Sitter
- Enclosure Bed
- Firm Restraints

Anti-Psychotics

- Atypicals (quetiapine, olanzapine, ziprasidone, aripiprazole)
  - DA blockers and 5-HT active
- Typical (haloperidol)
  - DA blocker



Side Effects

- Weight gain
- Hyperlipidemia
- Increased diabetes risk
- Drowsiness
- Tardive dyskinesia

Antiepileptics

- Carbamazepine
- Sodium valproate

- Side effects
  - Carbamazepine
    - Aplastic anemia
    - Agranulocytosis
    - Pancytopenia
    - Hepatotoxicity
    - SIADH
  - Sodium valproate
    - Hepatotoxicity
    - Hyponatremia
    - Myelosuppression
    - Aplastic anemia

Beta Blockers

- Non-selective (propranolol)
- Side effects
  - CHF
  - bradycardia

SSRI’s

- Zoloft
- The others
  - Lexapro
  - Celexa
  - Prozac

- Side Effects
  - Blackbox: suicidality
  - Serotonin syndrome
  - Hyponatremia
  - Hepatotoxicity
  - GI upset
  - Sexual side effects

Depression

- Zoloft, SSRI’s
- TCA’s
- SNRI’s
- Buproprion
- Methylphenidate

- Pathologic laughing/crying
  - SSRI’s
  - Nuedexta

Goals

- Arousal
- Attention/Processing Speed
- Memory

Dopamine active medications

- Amantadine
- Bromocriptine
- Carbidopa/levodopa

- Side effects
  - Psychosis/agitation
  - Arrhythmias
  - GI upset
  - Seizures

Stimulant Medications

- Ritalin
- Adderall
- Concerta

- Side Effects
  - Anorexia/weight loss
  - Psychosis
  - Arrhythmias
  - Seizures

Memory Medications

- Aricept
- Exelon
- Namenda

- Side Effects
  - Bradycardia
  - GI upset
  - Headache

Sleep

- Defense vs. Offense vs. Playing Field

Life Roles/Vocation

Re-integration Into Society

- Home Health
- Vocational Rehab
- Personal care attendants
- Adaptive Equipment
- Home modifications

Driving Evaluation

- Recommendations
  - Resume independent driving
  - Resume with adaptive equipment
  - Driving with restrictions in place
  - No driving due to high risk for accidents

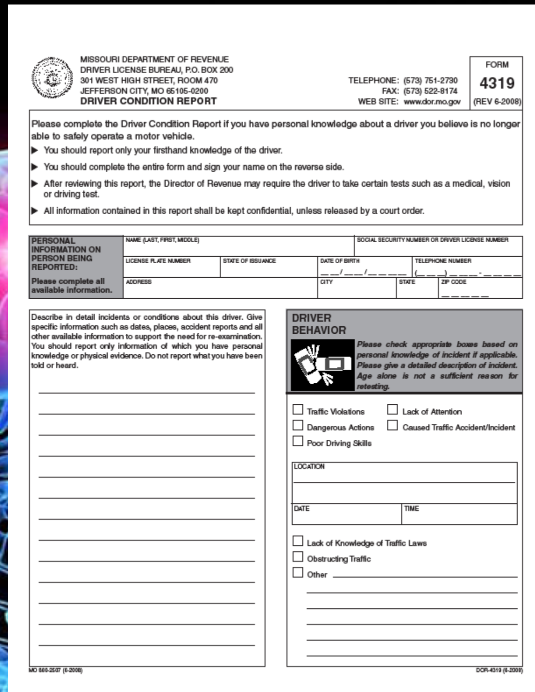
Missouri Regulations

- 6 months seizure free/stable on medication
  - Physician form needed if <6 months
- Not a mandatory reporting state
- No Physician liability currently

Reporting

- General Public
  http://dor.mo.gov/mvdl/drivers/forms/

- Physicians
  http://dor.mo.gov/mvdl/drivers/forms/



MISSOURI DEPARTMENT OF REVENUE
DRIVER LICENSE BUREAU, P.O. BOX 200
301 WEST HIGH STREET, ROOM 470
JEFFERSON CITY, MO 65105-0200
DRIVER CONDITION REPORT

TELEPHONE: (573) 751-2730
FAX: (573) 522-8174
WEB SITE: www.dor.mo.gov

FORM **4319** (REV 6-2008)

Please complete the Driver Condition Report if you have personal knowledge about a driver you believe is no longer able to safely operate a motor vehicle.

- You should report only your firsthand knowledge of the driver.
- You should complete the entire form and sign your name on the reverse side.
- After reviewing this report, the Director of Revenue may require the driver to take certain tests such as a medical, vision or driving test.
- All information contained in this report shall be kept confidential, unless released by a court order.

PERSONAL INFORMATION ON PERSON BEING REPORTED:
Please complete all available information.

NAME (LAST, FIRST, MIDDLE)		SOCIAL SECURITY NUMBER OR DRIVER LICENSE NUMBER	
LICENSE PLATE NUMBER	STATE OF ISSUANCE	DATE OF BIRTH __/__/____	TELEPHONE NUMBER (___) ___-____
ADDRESS	CITY	STATE	ZIP CODE

Describe in detail incidents or conditions about this driver. Give specific information such as dates, places, accident reports and all other available information to support the need for re-examination. You should report only information of which you have personal knowledge or physical evidence. Do not report what you have been told or heard.

DRIVER BEHAVIOR

Please check appropriate boxes based on personal knowledge of incident if applicable. Please give a detailed description of incident. Age alone is not a sufficient reason for retesting.

- ☐ Traffic Violations
- ☐ Lack of Attention
- ☐ Dangerous Actions
- ☐ Caused Traffic Accident/Incident
- ☐ Poor Driving Skills

LOCATION

DATE | TIME

- ☐ Lack of Knowledge of Traffic Laws
- ☐ Obstructing Traffic
- ☐ Other

MO 860-2507 (6-2008) DOR-4319 (6-2008)

MISSOURI DEPARTMENT OF REVENUE
DRIVER LICENSE BUREAU, P.O. BOX 200
301 WEST HIGH STREET, ROOM 470
JEFFERSON CITY, MO 65105-0200
PHYSICIAN'S STATEMENT

TELEPHONE: (573) 751-2730
FAX: (573) 522-8174
WEB SITE: www.dor.mo.gov

FORM **1528** (REV. 11-2008)

PLEASE READ THE FOLLOWING INFORMATION CAREFULLY BEFORE COMPLETING THIS FORM!

- **Completing this report does not violate physician/patient privilege, and when made in good faith the physician shall be immune from any civil liability that might otherwise result from making this report.**
- **You should complete and sign the Physician's Statement based on your examination of the patient, and indicate if he or she is capable of operating a motor vehicle safely and responsibly.**

PATIENT INFORMATION

PATIENT NAME (LAST, FIRST, MIDDLE)	SOCIAL SECURITY NUMBER ___-__-____	DATE OF BIRTH __/__/____	
PATIENT'S MAILING ADDRESS	CITY	STATE	ZIP CODE

MEDICAL CONDITIONS

PLEASE CHECK ☑ APPROPRIATE BOXES IF THE PATIENT BEING REPORTED HAS ANY OF THE FOLLOWING CONDITIONS THAT WOULD IMPAIR HIS OR HER ABILITY TO SAFELY OPERATE A MOTOR VEHICLE.

☐ **VISUAL IMPAIRMENT**

	Yes	No
Should patient be required to wear glasses/lenses while driving?	☐	☐
Should patient be restricted to daylight driving?	☐	☐
Does patient have visual field deficit which makes driving unsafe?	☐	☐

Additional comments:

VISION			
DISTANT VISION ONLY	RIGHT	LEFT	BOTH
WITH PRESENT CORRECTION	20/	20/	20/
WITHOUT CORRECTION	20/	20/	20/
BEST POSSIBLE CORRECTION	20/	20/	20/
FIELD	RIGHT °	LEFT °	
EYE DOCTOR SIGNATURE		DATE __/__/____	

☐ **HEARING — DO NOT COMPLETE UNLESS PATIENT IS SEEKING A COMMERCIAL DRIVER LICENSE**

☐ Normal ☐ Other (Please explain)

☐ **COGNITIVE IMPAIRMENT**

- ☐ Impaired Problem Solving, Decision Making, or Judgment
- ☐ Dementia
- ☐ Other (Please explain)

☐ **PSYCHIATRIC**

- ☐ Hallucinations or Delusions
- ☐ Other (Please explain)

MO 860-0448 (11-2008) DOR-1528 (11-2008)

Outpatient Continuation

BRAIN INJURY AND CONCUSSION CLINIC

Brain injuries, including concussions, are complex injuries that can significantly impact lives.

Lingering symptoms may include:

- HEADACHES
- FATIGUE
- MOOD CHANGES
- ABNORMAL BEHAVIOR
- CONFUSION
- DIZZINESS
- FOGGINESS
- MEMORY PROBLEMS
- NAUSEA
- UNSTEADINESS
- UNUSUAL SLEEPING PATTERNS
- VISION PROBLEMS

MU Health Care offers a multidisciplinary clinic for the evaluation and treatment of brain injuries/concussions, to help those affected maximize their quality of life. This clinic brings together experts from three key clinical areas focusing on recovering from brain injury/concussion: Physical Medicine and Rehabilitation, Neuropsychology and Therapy.

Physical Medicine and Rehabilitation Clinic
Second and Fourth Wednesday of every month, 8 am-noon.

To schedule an appointment, please call **(573) 884-0033**.

BRAIN INJURY AND CONCUSSION PROVIDERS

Physical Medicine and Rehabilitation

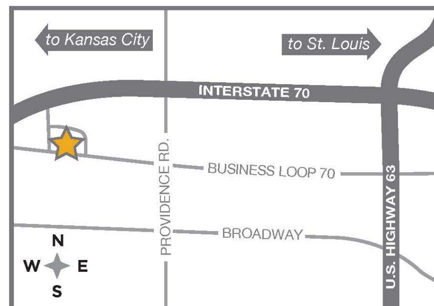
Christopher Wolf, DO, is board-certified in brain injury medicine and has over 12 years experience evaluating and treating varying levels of brain injury. He is the Director of Physical Medicine and Rehabilitation clinics and President of medical staff at Rusk Rehabilitation Center. Additionally, he serves as Director of the Traumatic Brain Injury Program.

Neuropsychology

Eric Hart, PsyD, ABPP-CN, is a licensed Psychologist, board-certified Neuropsychologist and an Associate Professor of Health Psychology with over 9 years experience working with patients. He has served as president of the Brain Injury Association of Missouri, local Brain Injury Support Group Facilitator and is currently the Director of Clinical Training for the Department of Health Psychology and Director of Adult Neuropsychology.

Mizzou Therapy Services

Lisa Smith, OTR/L, is an Occupational Therapist with almost 20 years of experience working with neurological injuries, including brain injury, in both the inpatient and outpatient setting. Lisa is trained in assessment and treatment of functional cognitive deficits and neurological vision impairments. In addition, she can provide assessment and skill training for returning to drive following a neurological injury.



Physical Medicine and Rehabilitation
315 Business Loop 70 West
Columbia, MO 65203
Phone: (573) 884-0033

http://www.muhealth.org/services/pmandr/brain-injury-and-concussion/

MULTI-DISCIPLINARY PROVIDERS:
Physical Medicine and Rehabilitation | Neuropsychology | Mizzou Therapy Services

References

- Congressional House Judiciary Committee Hearing
  Washington, D.C. Oct. 28, 2009
- Cantu RC, Voy R. Second impact syndrome: a risk in any sport. Physician Sports Med 1995: 23: 27-36; Collins MW Lovell MR, Current issues in Managing Sports Related Concussion. JAMA 1999 282 (24) 2283-2285.
- Halstead ME; McAvoy K, Devore CD, et al. Returning to learning following a concussion. Pediatrics 2013; 132:948
- Howell D, Osternig L, Van Donkelaar P, et al. Effects of concussion on attention and executive function in adolescents. Med Sci Sports Exerc 2013; 45:1030
- McCrory P, et al. Summary and agreement statement of the 3rd International Conference on Concussion in Sport, Zurich 2008.
- Moser RS, Glatts C, Schatz P. Efficacy of immediate and delayed cognitive and physical rest for treatment of sports-related concussion. J Pediatr 2012; 161:922
- Sady MD, Vaughan CG, Gioia GA. School and the concussed youth: recommendations for concussion education and management. Phys Med Rehabil Clin N Am 2011; 22:701
- Traumatic brain injury in the United States: Emergency department visits, hospitalizations and deaths 2002-2006. Atlanta, GA: Center for Disease Control and Prevention; 2006.
- Up To Date
- Zasler ND, Katz DI, Zafonte RD, eds. Brain Injury Medicine: Principles and Practice. Ch. 24 “Sport-Related Concussion”. Collins MW, Iverson GL, Gaetz M, Lovell MR