

Post-Traumatic Brain Injury Care in the Child and Adolescent

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Meet the Speakers

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Disclosures



We have no financial disclosures



Learning Objectives



Mild TBI:

Definition
Symptoms
Tests
Treatment
Returning to school/activities



Moderate to Severe TBI:

Definition
Symptoms
Tests
Treatment
Returning to school/activities



Special Considerations:

Young children
NAT
Driving

Mild Traumatic Brain Injury





Mild Traumatic Brain Injury: Defined

- Definition: results from a jolt to the head that creates chemical changes in the brain and sometimes stretching and damaging brain cells. This causes temporary mental status changes
- Synonyms: “concussion”

	Mild
Glasgow Coma Scale	13-15
Loss of consciousness	<30 min
Post-traumatic Amnesia	<24 hours
Imaging: CT, MRI	Normal
Focal signs	Changes in cognition, sensation, Emotion



Mild Traumatic Brain Injury: Symptoms

- **Headache:** most common symptom
 - **Sensation:** hearing, vision, impaired perception, vestibular dysfunction
 - **Emotion:** depression, anxiety, impulsivity, personality changes
 - **Cognitive:** impaired memory, processing, attention and sleep
 - **Motor:** imbalance, impaired coordination
- * Duration of concussion symptoms cannot be determined at the time of the injury
- * Patient's report of return to baseline precedes actual neuropsychological recovery



Mild Traumatic Brain Injury: Tests

- Maybe CT Head
- Neurocognitive testing
- Vestibular Evaluation

Key Recommendations from the CDC Pediatric mTBI Guideline



- Do not routinely image patients to diagnose mTBI.
- Use validated, age-appropriate symptom scales to diagnose mTBI.
- Assess evidence-based risk factors for prolonged recovery.
- Provide patients with instructions on return to activity customized to their symptoms.
- Counsel patients to return gradually to non-sports activities after no more than 2-3 days of rest.



CDC: Imaging for concussions

- Healthcare providers should not routinely obtain a head CT for diagnostic purposes in children with mTBI
- For children diagnosed with mTBI, healthcare providers should discuss the risk of a pediatric head CT in the context of risk factors for intracranial injury (ICI) with the patient and his/her family.
- It is critical to rule out ICI while avoiding unnecessary risks related to exposure from a head CT. Strong clinical evidence indicates that use of clinical decision rules are effective in identifying children at low risk for ICI.

CDC: Indications for CT

- Age < 2 years old
- Loss of consciousness
- Severe mechanism of injury
- Vomiting
- Amnesia
- Clinical suspicion for skull fracture
- Severe or worsening headache
- Non-frontal scalp hematoma
- Glasgow Coma Score < 15





Red Flags for Emergency Care

- Headache that worsens
- Seizures
- Focal neurologic signs
- Looks very different or drowsy
- Repeated vomiting
- Slurred speech
- Unable to recognize people or places
- Increasing confusion or irritability
- Weakness or numbness in arms/legs
- Neck pain
- Unusual behavioral changes
- Change in state of consciousness



Mild Traumatic Brain Injury: Neurocognitive testing



- Brief computerized cognitive evaluation tools are a commonly utilized component of mTBI management
- For athletes, they may complete baseline computer-based testing in order to determine how he/she is functioning prior to concussion/mTBI (most common is ImPACT)
- Tests measure reaction time, memory, and other neurocognitive functions, such as concentration, attention.
- Follow-up tests are used to monitor resolution of neurocognitive and other post-concussive symptoms.
- There are validity measures within the tests and the test results should be reviewed by someone knowledgeable of the test
- Neurocognitive tests provide an aid to the clinical decision-making process in conjunction with a range of assessments of different clinical domains. Results should not be the sole basis of management decisions with regards to return to activities.
- Only for mTBI, not for moderate or severe TBI

Mild Traumatic Brain Injury: Vestibular Evaluation



- **BALANCE:**
 - Single leg stance with eyes open:
 - Single leg stance with eyes closed:
- **EYE GAZE ASSESSMENT:**
 - Near point convergence midline:
 - Near point convergence superior:
 - Smooth Pursuit:
 - Horizontal saccades:
 - Vertical saccades:
 - Horizontal VOR:
 - Vertical VOR:
 - Nystagmus:
 - Symptomatic with exam?



Mild Traumatic Brain Injury: Treatment



- Medications:
 - Headache: OTC, NSAID, SNRI, TCA
- Therapies: PT, OT, Speech and Language, Vestibular
- Usually doesn't require intensive inpatient rehabilitation in a hospital
- Neuropsychology/Psychology



Mild Traumatic Brain Injury: Return to School

- Goals
 - Avoid academic and social failure during time they are recovery
 - Slowly transition back into school
 - Offer supportive services
- Physical rest: 2-3 days, no playing, wrestling, PE, leisure activities
- Cognitive rest: 2-3 days (<1 week), minimize screens or school-work, avoid loud-busy environments
- Slow transitions: consider ½ days, “symptom driven” (encourage high function without symptoms), may need short-term accommodations (504 plan)

Mild Traumatic Brain Injury: Return to School



Accommodations can be written in a letter by the doctor

- Rest periods
- Modified PE
- Lunch in a quiet room with 1-2 friends
- Change classes off schedule to avoid busy halls
- Decrease screen and reading time
- Provide copy of notes to student
- Quiet rooms for testing
- Extended time for assignments and tests
- Provide written instructions
- Reduce schoolwork overall
- Assistance with organization



Prevention of Second Impact Syndrome

- Occurs when a second head injury is sustained before the initial head injury symptoms have resolved.
- Can get cerebral vascular congestion, increased ICP
 - > diffuse cerebral swelling, herniation and death
- Seen more in younger individuals (<21 yo)
- Can be caused by less force
- Usually within 14 days of initial head injury



Mild Traumatic Brain Injury: Return to Activities



- “symptom driven”
- sub-symptom exercise
 - Light activities first -> outside, walking, running by self
 - Sport-specific -> drills, non-contact sport specific drills, contact drills, full contact
- If successful at each stage for 1-2 days, then ok to continue to progress
- Back down to prior level if symptomatic

Mild Traumatic Brain Injury: Returning to Driving



- Comparing 18-22 year olds with and without concussion, on safety of driving
- Used a symptom checklist, brief neuropsychological exam, and driving simulation task
- Participated within 48 hours of becoming “asymptomatic”
- Evaluated crashes, tickets, lane excursions, and deviations in lane lateral position and speed.
- Results: Despite feeling asymptomatic, those with concussion had more lane excursions, greater deviation in lane position, more variations in speed, and overall poorer vehicle control, especially when managing curves.
- Some of these findings are similar to those found in Parkinson disease
- Driving impairments may persist beyond when individuals have returned to driving
- This is especially concerning when considering returning new drivers to the road

Moderate and Severe Traumatic Brain Injury



Moderate and Severe TBI: Defined



- Definition: blow to the head causing injury to the brain tissue, resulting in deficits and symptoms that are different from functional baseline

	Mild	Moderate	Severe
Glasgow Coma Scale	13-15	9-12	3-8
Loss of consciousness	<30 min	>30 min-24 hours	>24 hours
Post-traumatic Amnesia	<24 hours	24 hours-1 week	>1 week
Neuroimaging	Normal	+findings	+findings
Focal signs	Cognitive deficits	Cognitive deficits Motor deficits	Cognitive deficits Motor deficits



Moderate and Severe TBI: Symptoms

- **Sensation:** impaired hearing, impaired vision, impaired perception, vestibular dysfunction
- **Motor:** imbalance, extremity weakness, impaired coordination, neurogenic bowel and bladder, hypertonicity
- **Cognitive:** impaired memory, impaired reasoning, slowed processing, impaired attention and sleep disruption, aphasia
- **Emotion:** depression, anxiety, impulsivity, personality changes, dysregulation, pseudobulbar affect



Moderate and Severe TBI: Tests

- Static Imaging: CT & MRI
- **CT head without contrast**
 - What it shows: hemorrhage, petechial hemorrhage
 - When to get it: immediate upon any ER visit, continued symptoms without improvement, red flag symptoms
- **MRI Brain without contrast**
 - What it shows: more sensitive to see traumatic injuries, axonal damage
 - When to get it: within 7-10 days of injury
- Dynamic Imaging: PET & SPECT
- **PET – position emission tomography**
- **SPECT – single-photo emission computed tomography**
 - What it shows: subtle abnormalities
 - When to get it: suspect TBI, but CT negative



Moderate and Severe TBI: Tests

Neuropsychological Assessment

- Tests designed to assess the different facets of brain-based behavior
- Focus more on neuro than psychological
- Takes anywhere from 4-8 hours, typically
- Assessing for abnormal vs. typical performance
- Looking at higher order functions and central processing whereas neurological diagnostic assessments are looking at lower-level aspects of brain functioning
- CT and especially MRI allow identification of abnormalities in brain structure, but do not give us information about the specific function of that individual
- NPSY testing complements other diagnostic tools

Domains Assessed in NPSY Testing



- Intellectual Abilities--IQ
- Academic Abilities
- Memory/Learning
 - Visual
 - Verbal
 - Short term
 - Long term
- Language/Vocabulary
- Visual-Spatial/Visual-Motor/Visual-Perceptual
- Fine Motor Functioning
- Processing Speed
- Attention/Concentration
- Working Memory
- Other Executive Functions
 - Planning
 - Organization
 - Problem Solving
 - Abstract Reasoning
 - Mental Flexibility
- Adaptive Functioning
- Behavioral Functioning (Observations and Questionnaires)
- Emotional/Social Functioning

Who is NOT appropriate for NPSY testing?



Persons who:

- Have Intellectual Deficiency-extensive testing not necessary or helpful
- Are in very early stages of recovery- they change rapidly, and the results have very limited application
- Have significant distractibility
- Are unwilling/uncooperative



*Below school-age-would consider it a “Developmental Assessment” rather than NPSY Assessment





Moderate and Severe TBI: Treatment

- Medication:
 - Cognition: neurostimulants
 - Sleep: sleep aids
 - Abnormal tone: anti-spasmodics, or anti-dystonics
 - Urinary incontinence: anti-cholinergics
 - Neurogenic bowel: softeners, stimulants, laxatives
- Inpatient Rehabilitation
- Therapies: PT, OT, SLP, music, recreational, vision
- Neuropsychology/Psychology



Moderate and Severe TBI: Return to School

- May be a slower return to school due to a prolonged hospitalization, more severe symptoms, and need for more accommodations/modifications
- May have to consider
 - Home bound school
 - Slower transition back to in person school
 - 504
 - IEP
 - Therapies

Moderate and Severe TBI: Return to School

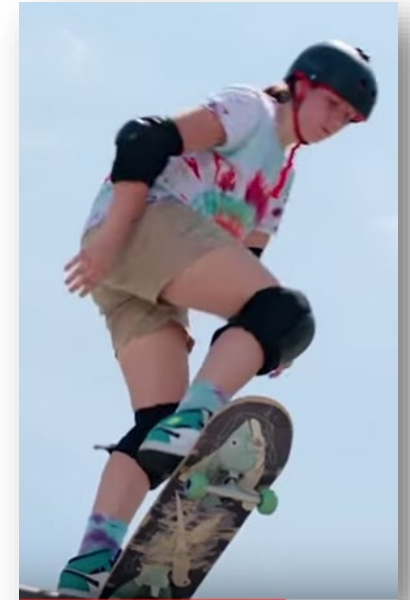


- Accommodations:
 - 504
 - Section 504 of the Rehabilitation Act of 1973.
 - Provides equal access to education for people with disabilities. Provides accommodations developed by a team and is time limited. Lists specific adjustment to learning environment, modifications to curriculum, requested by teachers or parents. Ex: increased time, leaving the classroom, breaks, larger printer, spoken directions, reminders to pay attention.
 - IEP
 - Individualized Education Program. From the Individuals with Disabilities Education Act.
 - Child must fit under at least one of 13 disability categories (TBI is one, as is OHI). More structured and specific than a 504 and requires documentation of measurable growth. Includes therapies during school.



Moderate and Severe TBI: Return to Activities

- No return to leisure-wheeled activities or higher risk activities for at least one year (biking, roller blades, skateboard, tumbling, trampoline, ATV, dirt bikes)



Special Considerations



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Age Matters: Pediatric Brain Injury



- **YOUNGER = WORSE OUTCOMES**

- Outcome for children <7 y.o. were worse over time than those whose TBI occurred when they were >7 y.o.
- This is especially true when the child is less than 2 y.o.
- The younger children were at the time of their TBI, the more likely children will grow up with severe, permanent deficits.
- Young children are especially vulnerable to the effects of brain injury

- **DEVELOPMENTAL SKILLS ARE IMPACTED**

- Previously developed skills may be preserved after brain injury, but new learning is more difficult to acquire
- Effects of brain injury may not be apparent until more advanced skills are expected to develop
- A child may return to the previous developmental level following TBI, but may have trouble progressing past that stage



Non-Accidental Trauma

- Compared to accidental TBI, children who sustained abusive head traumas tend to have:
 - Lower initial GCS
 - More frequent signs of acute cardiorespiratory compromise
 - More frequent and prolonged impairments of consciousness
 - More frequent bilateral HIE or swelling
 - Significantly higher incidence of pre-existing brain abnormalities prior to TBI
 - Higher mortality rate
 - Poorer long-term outcome



On the Road Again

- Driving is one of the most QOL concerns for individuals who drive and had a TBI. Helps with engagement, re-integration, independence, and life perception.
- Almost 60-70% of mod-severe TBI adults return to driving.
 - However, the ability to drive safely is not tested in about 60-70% of cases
- Skills that are essential for driving can be impacted: maintaining lane, accurate vision, concentration, memory functioning, recall, problem solving, hand-eye coordination, motor planning, reaction time, safety, awareness, judgement
- Those with TBI and CVA have larger self-reported and Motor Vehicle Safety reported crashes compared to non-injured cohorts.
- By contrast, a 5-year post-injury study of individuals with BI, which included only those that had received driver assessment and rehabilitation, did not find a higher rate of accident involvement compared to a match control. (Schultheis, MT 2002. Driving After TBI)



Driver's Evaluation & Training

- Evaluations: often “off-the-road” and “on-the-road”
 - Driver's safety and control
 - Clinical testing based on diagnosis: cognitive, physical, vision, emotional stability, multitasking
 - Therapist recommendations for equipment or modifications
 - Adaptive equipment evaluation
- Training:
 - Individual sessions to focus on skills from evaluation
 - Proficiency with adaptive equipment
 - Defensive driving
- Usually out of pocket expense, but <\$200-500
- Locations nearby: Ability KC (KC,MO), St. Luke's (OP, KC, Lee's Summit, Smithville), Mercy (Chesterfield, MO), Cox Health (Springfield, MO), Avenues (Overland Park), KU Health



Major Take- aways

- Mild, moderate and severe brain injuries are defined by GCS, imaging and deficits.
- Severity of the brain injury is important for prognosis, post-injury symptoms, treatment and overall outcomes.
- Treatment of brain injury patients is multidisciplinary, and requires numerous things – medications, therapies, referrals, additional testing, and regular follow up
- Pediatric TBIs can have worse outcomes than adult TBIs
- For pediatric TBIs, we must assist them in getting back to life – including school, activities, and driving, while being mindful of allowing the brain to heal and avoidance of second impact syndrome.



Testing Our Knowledge



True or False

- Traumatic brain injury in children is less severe than in adults, because their brains are still developing, and they can recover faster.

True or False

- All children, regardless of age or severity of their trauma, should receive a head CT to rule out any brain damage.

True or False

- Neuropsychological testing is best for those who are <5 years old and completed within 1-2 weeks of the traumatic brain injury.

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Thank you

Any questions?



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