Recognizing and Managing Concussion and Sports Concussion in the Collegiate Setting

Brian P Rieger, PhD

Chief Psychologist & Clinical Assistant Professor

Department of Physical Medicine & Rehabilitation

University**Hospital** · SUNY Upstate Medical University

Director, Concussion Management Program
& CNY Sports Concussion Center
NYSPHSAA Concussion Team & Safety Committee
NYS TBI Coordinating Council · Public Education Committee

NYSCHA 2008 Annual Meeting

Concussion

- Definitions and diagnostic criteria
- Epidemiology and pathophysiology
- Post-concussion symptoms
- Typical and complicated recovery
- Treatment and management
- Return to school and play
- Role of neuropsychological testing
- New developments

What is a concussion?

- **Mild traumatic brain injury**
- **A disruption in normal brain function due to a blow or jolt to the head**

  Centers for Disease Control

- **A trauma induced alteration in mental status that may or may not involve loss of consciousness**

  American Academy of Neurology

Definition of Concussion

American Congress of Rehabilitation Medicine

- Blow or jolt to the head *AND*
- Loss of consciousness (≤ 30 min) *OR*
- Post-traumatic amnesia (≤ 24 hrs) *OR*
- Focal neurological finding *OR*
  - Slurred speech, diplopia, etc.
- Alteration in mental state
  - Dazed or disoriented or confused
- After 30 minutes, an initial GCS of 13-15

symptoms are non-specific so rule out other causes

Glasgow Coma Scale (GCS)

Eyes Open	Never	1
	To pain	2
	To verbal stimuli	3
	Spontaneously	4
Best Verbal Response	No response	1
	Incomprehensible sounds	2
	Inappropriate words	3
	Disoriented and converses	4
	Oriented and converses	5
Best Motor Response	No response	1
	Extension	2
	Flexion abnormal	3
	Flexion Withdrawal	4
	Localizes pain	5
	Obeys	6

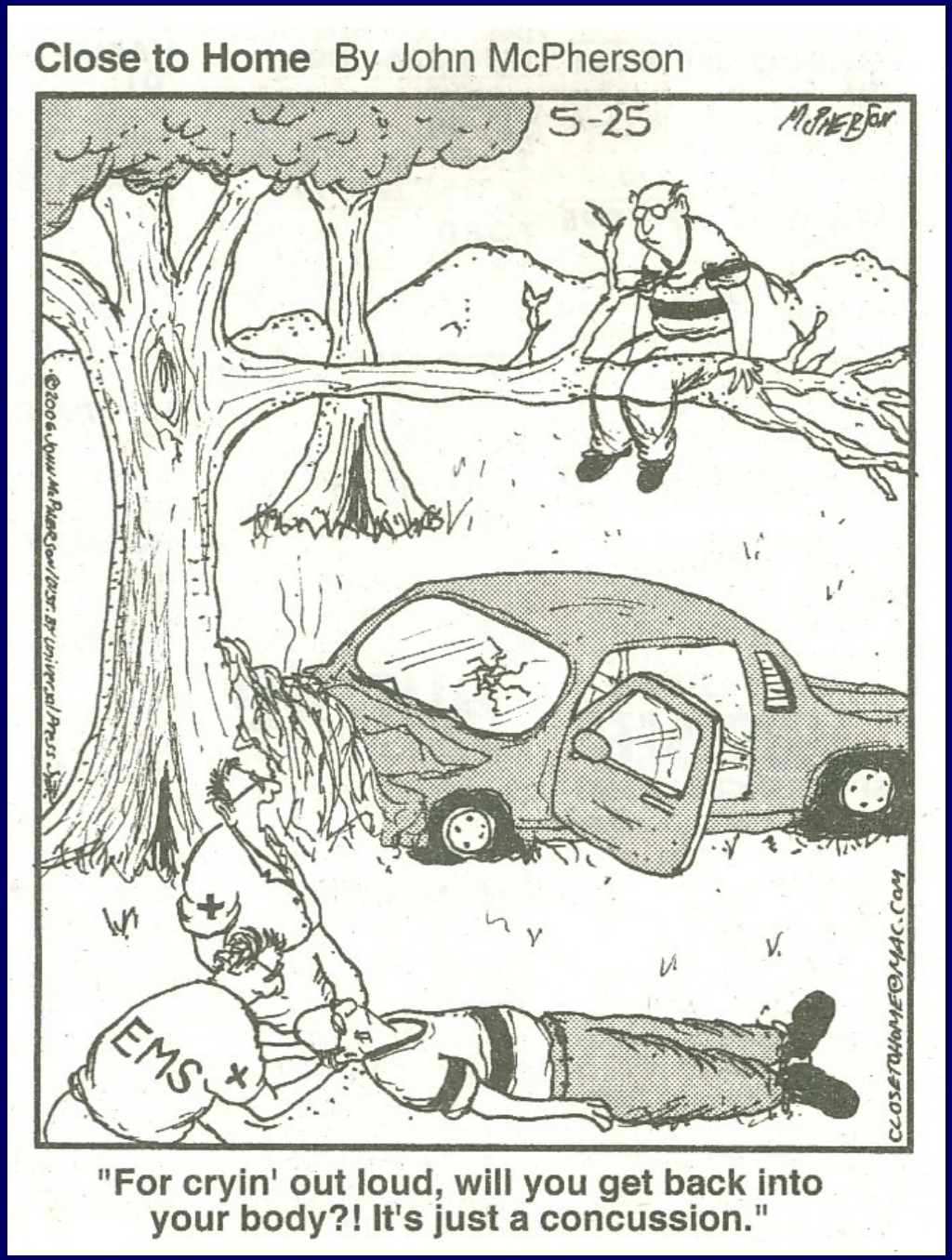
Scores of 13-15 indicate MTBI

TBI Classification

NCIPC 2003 • ACRM 1993

Measure	Mild	Moderate	Severe
Glasgow Coma Scale	13-15	9-12	3-8
Loss of Consciousness	≤ 30 mins	< 36 hours	> 36 hours
Post-traumatic Amnesia	≤ 24 hours	1-7 days	> 7 days

mild **does not refer to outcome**



It's just a concussion.

Definition of Concussion
American Academy of Neurology

- **Trauma-induced alteration in mental status**
- **Frequently *observed* features (signs):**
  - **Vacant stare (befuddled facial expression)**
  - **Slow or delayed verbal and motor responses**
  - **Confusion, disorientation, or inability to focus**
  - **Slurred or incoherent speech**
  - **Gross observable incoordination**
  - **Emotions out of proportion to circumstances**
  - **Memory deficits**
  - **Any period of loss of consciousness**

Outdated AAN Criteria for Sports-related Concussion

Grade 1 Transient Confusion
Symptoms resolve in <15 minutes
No LOC

Grade 2 Transient Confusion
Symptoms last >15 minutes
No LOC

Grade 3 LOC: a) brief
b) prolonged

Prague Guidelines
(McCrory et al., 2004)

- **Simple concussion**
  - ✓ LOC < 1 minute
  - ✓ resolves in 7-10 days
  - ✓ first concussion
- **Complex concussion**
  - ✓ LOC > 1 minute
  - ✓ symptoms last longer than 7 – 10 days
  - ✓ history of multiple concussions
  - ✓ increasing "concussability"

No athlete returns in the current game or practice

IOC • IIHF • FIFA

Epidemiology of Concussion

- At least 1.5 million brain injuries per year in the United States
- 80% of all injuries are mild (MTBI)
- Up to 1 million additional injuries which are not recognized or reported
- Economic and societal costs of concussion are not well documented

Epidemiology of Concussion

- Falls, motor-vehicle accidents, and assaults are the most common causes
- The risk of TBI is highest among those age 15-24
- Risk of TBI is 4-6 times greater after one, and 8 times greater after two

Mechanisms of Injury

- A complex physiological process induced by traumatic biomechanical forces
  - sudden chemical changes
  - stretching and tearing of brain cells
- Structural brain imaging (CT or MRI) is almost always normal

Neurometabolic Cascade
(Giza and Hovda 2001)

- Abrupt neuronal depolarization
- Release of excitatory neurotransmitters
- Changes in glucose metabolism
- Altered cerebral blood flow
- The brain goes into an ***ENERGY CRISIS*** that typically lasts up to 7 – 10 days

symptoms often get worse before they get better

Common Physical Symptoms

- Headache
- Dizziness and lightheadedness
- Clumsiness and poor balance
- Fatigue and lack of energy
- Sleep disturbance
- Blurred vision and light sensitivity
- Ringing in the ears

Common Emotional Symptoms

- Irritability
- Anxiety
- More extreme moods
- Easily overwhelmed
- Emotional and behavioral outbursts
- Lack of motivation

Common Cognitive Symptoms

- Feeling 'dazed' or 'foggy' or 'fuzzy'
- Easily distracted and easily losing track of things
- Trouble doing more than one thing at a time
- Poor learning and memory
- Poor reading comprehension

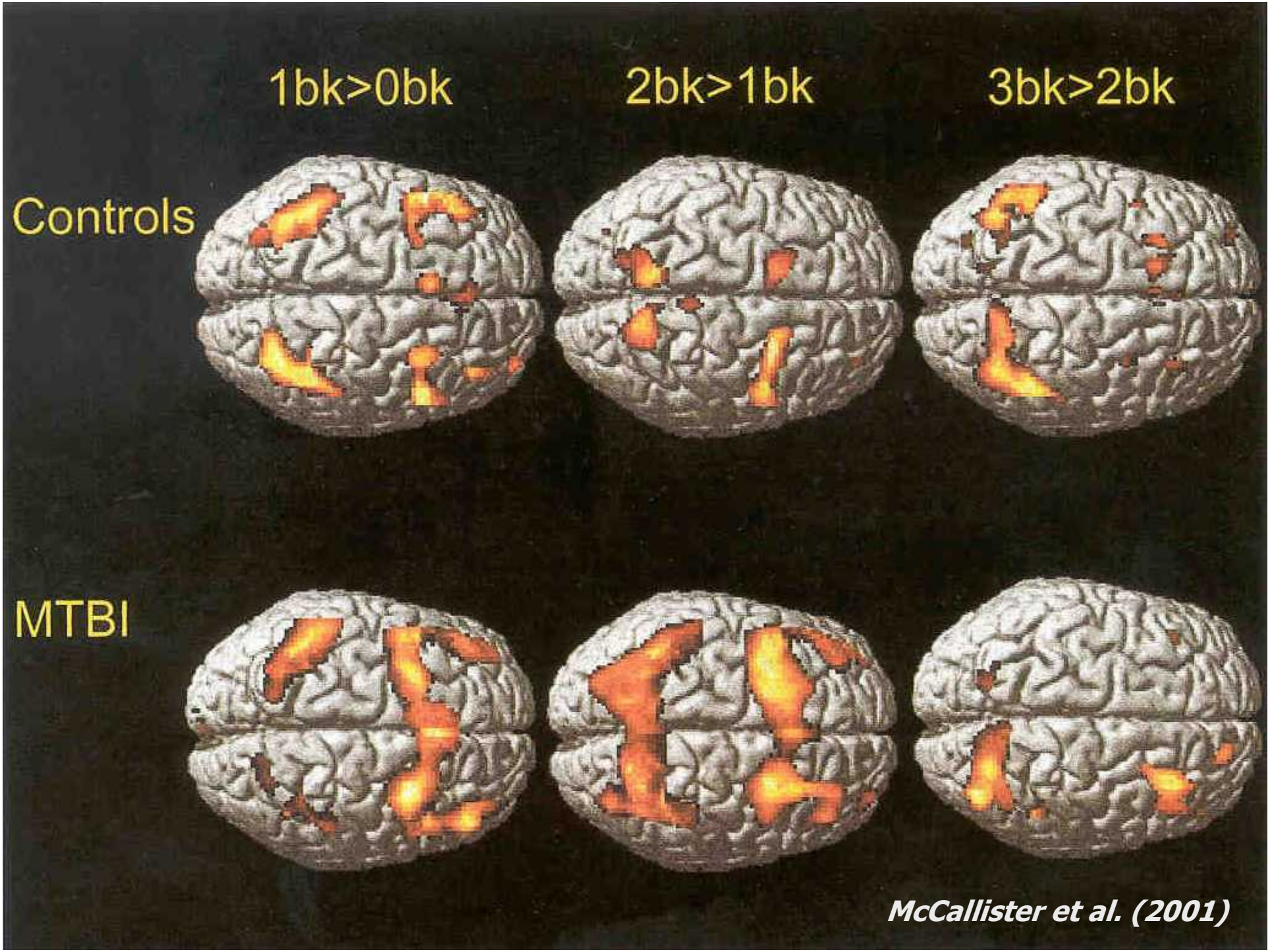
Common Cognitive Symptoms

- **Word-finding problems, and trouble putting thoughts into words**
- **Stuttering, slurred or scrambled speech**
- **Slowed processing**
- **Poor organization**
- **Easily confused**
- ***Poor mental stamina***

Exertion effects

- **Symptoms are worsened by . . .**
  - ✓ **mental effort**
  - ✓ **environmental stimulation**
  - ✓ **emotional stress**
  - ✓ **physical activity**

Functional MRI


1bk>0bk
2bk>1bk
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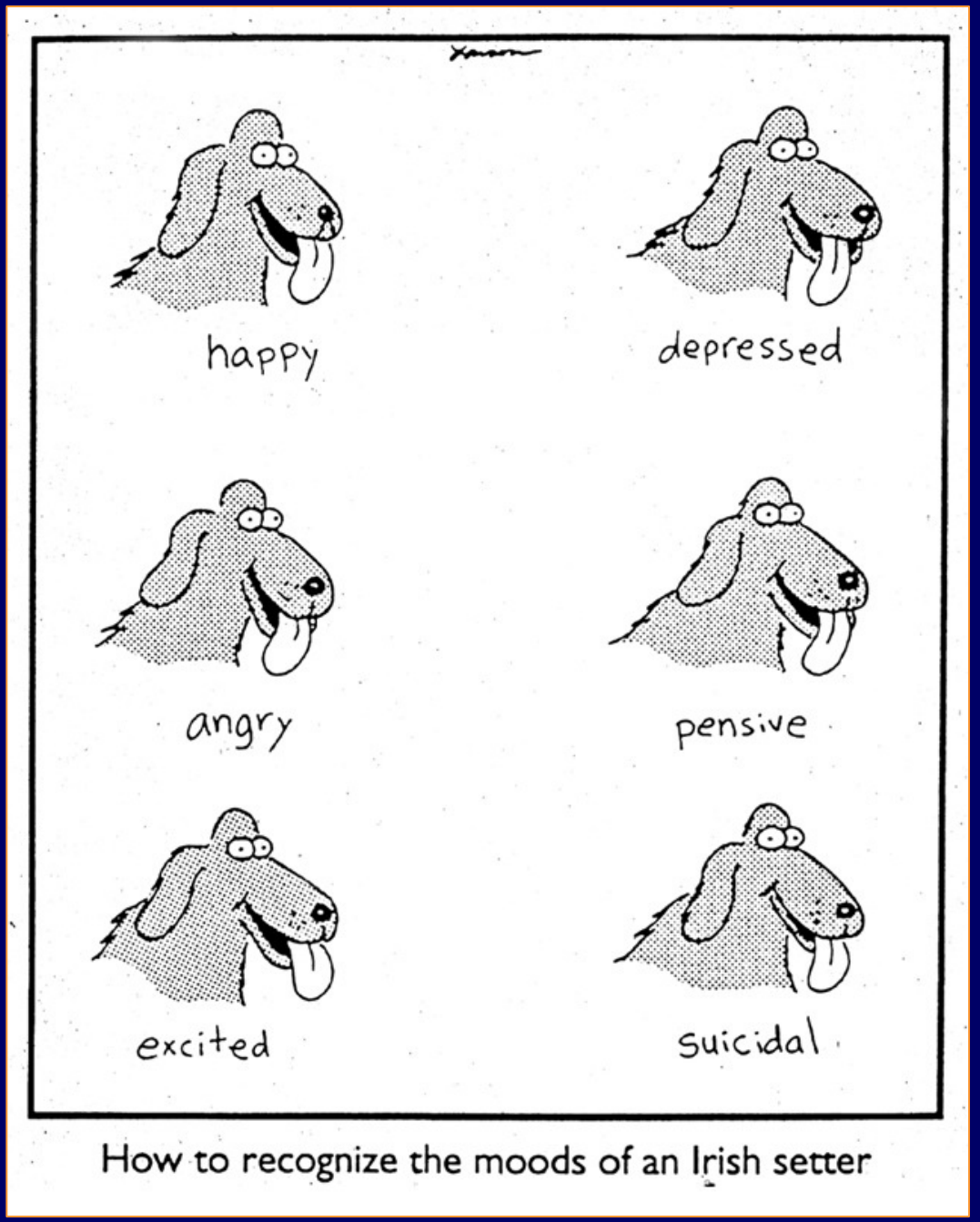
Controls
MTBI
McCallister et al. (2001)

Recovery from Concussion

- **Full recovery in 7-10 days. . .*in most cases***
- **About 95% recover in 3 months**
- **Symptoms generally thought to have a primarily neurological basis <u>at first</u>**
- **When symptoms persist, non-injury factors appear to play an increasingly significant role over time**

a *'miserable minority'* experience complicated recovery

- **Outcome after concussion is difficult to predict**
- **Early markers <u>weakly</u> related to recovery**
  - ✓ **LOC**
  - ✓ **GCS score**
  - ✓ **PTA**



Post-Concussion Syndrome (PCS)

- Term used to describe the constellation of symptoms after concussion
- Originally used when symptoms lasted longer than 3 months
- Controversial
  - What are the causes of persistent symptoms?
  - Does such a 'syndrome' exist?
  - Overlap of symptoms with other conditions
  - Neurological vs. psychological?

Post-concussion syndrome

Risk factors for complicated recovery

- Re-injury before complete recovery
- Over-exertion, especially early after injury
- Significant stress
  - Unable to participate in sports or exercise
  - Medical uncertainty
  - Academic difficulties
- Prior illness or injury
  - TBI
  - Seizure
  - Migraine

Post-concussion syndrome
Risk factors for complicated recovery

- Psychiatric history
  - Depression
  - Post-traumatic stress disorder
- Medical & psychological complications
  - Iatrogenesis & symptom expectancy
  - Pain & pain medication
  - Loss of self-confidence
  - Depression or anxiety
- Contextual variables
  - Litigation
  - Pressure to return to. . .

Secondary Problems in PCS

- **Invisible Injury – person looks the same and no medical evidence of injury**
- **Poorly understood by doctors, employers, teachers, coaches, family and friends**
- **Expectation from self and others to 'get over it' and 'get back in the game'**

most people think the symptoms of a concussion will only last a few days

"Mr. Osborne, may I be excused? My brain is full."

Don't all kids have these problems ?

Take two aspirin, then win the game

Notre Dame's Chris Thomas suffers a concussion, but hits the late game-winner.

The Associated Press

A concussion couldn't stop Chris Thomas. Neither could St. John's.

Thomas, who missed the first eight minutes of the second half with a concussion, faked out St. John's Daryll Hill and hit a 3-pointer with 6.5 seconds left to give Notre Dame a 67-66 victory over the Red Storm on Saturday at South Bend, Ind.

BIG EAST

"It was a broken play. But that's how it was going the whole game," Thomas said. "I got up a good pass fake and Hill lost his footing."

Notre Dame coach Mike Brey said he was surprised to see Thomas return to the bench in the second half, saying it looked as if there was no chance at half-

The Associated Press

NOTRE DAME'S Colin Falls *(15)* hugs teammate Chris Thomas following the Irish's 67-66 win over St. John's Saturday. Thomas suffered a concussion, but returned to the game to make the winning basket.

Wildcats honored their 1985 title team

Syracuse Post-Standard

Jan 16, 2005

Public misconceptions about TBI

Guilmette & Paglia (2004)

60% agree . . . ***How quickly a person recovers from head injury depends mainly on how hard they work at recovering.***

40% agree . . . ***Sometimes a second blow to the head can help a person remember things that were forgotten.***

Willer et al. (1993) results are similar for WNY

The NEW ENGLAND JOURNAL *of* MEDICINE

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Concussion

Allan H. Ropper, M.D., and Kenneth C. Gorson, M.D.

"Concussion" refers to an immediate and transient loss of consciousness accompanied by a brief period of amnesia after a blow to the head.

Considerable confusion persists among physicians and the public regarding concussion and the post-concussion syndrome.

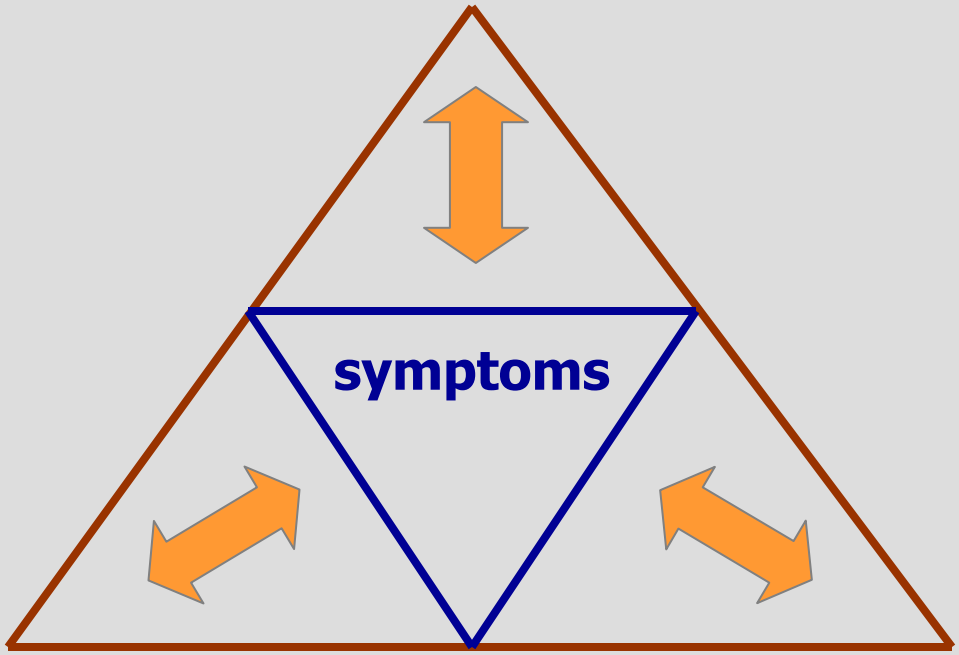
Secondary Problems in PCS

- **Symptoms can disrupt vocational, academic, social, and recreational activities**
- **Changes in functioning can lead to changes in self-confidence and identity**
- **Risk of anxiety, depression and withdrawal**

many patients think they are just lazy or crazy

Post-concussion syndrome

Neurological



Psychological

Contextual

Principles of Concussion Treatment

- No cure, but treatment reduce symptoms and improve functioning
- Early recognition, education and reassurance is critical, and can improve outcome
- Avoid re-injury and over-exertion while symptomatic
- Monitor until recovered

just knowing what's going on is a big help

Acute Management of Concussion

- Is it a concussion?
- Rule out more severe injury (head CT?)
- Monitor for deterioration in first 24h
- Screen for possible complicating factors
- Provide education and reassurance
- Prescribe rest and symptom relief
- Schedule follow-up
- Gradual return to activity as tolerated

Symptom Relief

- Rest
- Fluids
- Analgesia
  - Acetaminophen
  - Ibuprofen
  - Opioids
- Nausea and Vomiting
  - Insure hydration
  - Ondansetron
  - Avoid sedating antiemetics

When to go to the Emergency Department ?

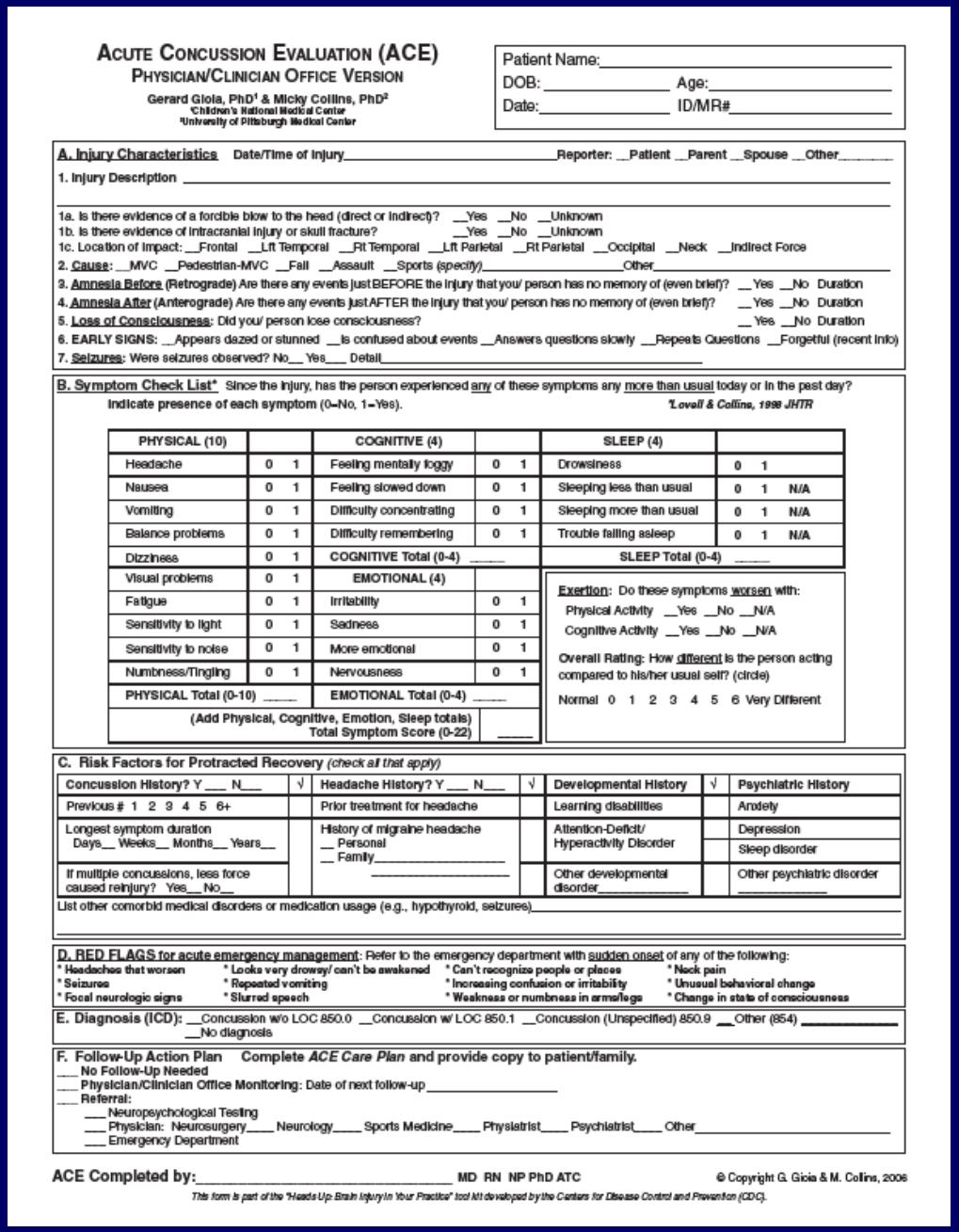
- Loss of consciousness (> 1 min)
- Severe headache
- Headache with nausea and vomiting
- Lethargy and difficult to arouse
- Significant vision problems
- Significant confusion or agitation
- Worsening symptoms
- “Something’s just not right”

Who Needs a CT? Adult Data

- 6 – 9% of patients with apparently minor HT will have positive CT scan
- < 1% require neurosurgical intervention
- Seven indicators (Hayel, et al. 2000)
  - Short–term memory
  - Intoxication
  - Trauma above clavicles
  - Age > 60
  - Headache
  - Vomiting

Who Needs a CT? Pediatric Data

- If none of the following present, then negative predictive value is essentially 100% (Palchak et al., 2003)
  - Clinical signs of skull fracture
  - Altered mental status
  - Headache
  - Vomiting



ACUTE CONCUSSION EVALUATION (ACE)

PHYSICIAN/CLINICIAN OFFICE VERSION

Gerard Gioia, PhD[1] & Micky Collins, PhD[2]
[1]Children's National Medical Center
[2]University of Pittsburgh Medical Center

Patient Name:_____
DOB:_____ Age:_____
Date:_____ ID/MR#_____

A. Injury Characteristics Date/Time of Injury_____ Reporter: __Patient __Parent __Spouse __Other_____

1. Injury Description _____

1a. Is there evidence of a forcible blow to the head (direct or indirect)? __Yes __No __Unknown
1b. Is there evidence of intracranial injury or skull fracture? __Yes __No __Unknown
1c. Location of Impact: __Frontal __Lft Temporal __Rt Temporal __Lft Parietal __Rt Parietal __Occipital __Neck __Indirect Force
2. Cause: __MVC __Pedestrian-MVC __Fall __Assault __Sports (specify)_____Other_____
3. Amnesia Before (Retrograde) Are there any events just BEFORE the injury that you/ person has no memory of (even brief)? __Yes __No Duration
4. Amnesia After (Anterograde) Are there any events just AFTER the injury that you/ person has no memory of (even brief)? __Yes __No Duration
5. Loss of Consciousness: Did you/ person lose consciousness? __Yes __No Duration
6. EARLY SIGNS: __Appears dazed or stunned __Is confused about events __Answers questions slowly __Repeats Questions __Forgetful (recent info)
7. Seizures: Were seizures observed? No__ Yes___ Detail_____

B. Symptom Check List* Since the injury, has the person experienced any of these symptoms any more than usual today or in the past day?
Indicate presence of each symptom (0=No, 1=Yes). *Lovell & Collins, 1998 JHTR

PHYSICAL (10)		COGNITIVE (4)		SLEEP (4)	
Headache	0 1	Feeling mentally foggy	0 1	Drowsiness	0 1
Nausea	0 1	Feeling slowed down	0 1	Sleeping less than usual	0 1 N/A
Vomiting	0 1	Difficulty concentrating	0 1	Sleeping more than usual	0 1 N/A
Balance problems	0 1	Difficulty remembering	0 1	Trouble falling asleep	0 1 N/A
Dizziness	0 1	COGNITIVE Total (0-4) ____		SLEEP Total (0-4) ____	
Visual problems	0 1	EMOTIONAL (4)			
Fatigue	0 1	Irritability	0 1		
Sensitivity to light	0 1	Sadness	0 1		
Sensitivity to noise	0 1	More emotional	0 1		
Numbness/Tingling	0 1	Nervousness	0 1		
PHYSICAL Total (0-10) ____		EMOTIONAL Total (0-4) ____			
(Add Physical, Cognitive, Emotion, Sleep totals) Total Symptom Score (0-22)	____				

Exertion: Do these symptoms worsen with:
Physical Activity __Yes __No __N/A
Cognitive Activity __Yes __No __N/A

Overall Rating: How different is the person acting compared to his/her usual self? (circle)
Normal 0 1 2 3 4 5 6 Very Different

C. Risk Factors for Protracted Recovery *(check all that apply)*

Concussion History? Y___ N___	√	Headache History? Y___ N___	√	Developmental History	√	Psychiatric History
Previous # 1 2 3 4 5 6+		Prior treatment for headache		Learning disabilities		Anxiety
Longest symptom duration Days__ Weeks__ Months__ Years__		History of migraine headache __ Personal __ Family_____		Attention-Deficit/ Hyperactivity Disorder		Depression
						Sleep disorder
If multiple concussions, less force caused reinjury? Yes__ No__				Other developmental disorder_____		Other psychiatric disorder _____

List other comorbid medical disorders or medication usage (e.g., hypothyroid, seizures)_____

D. RED FLAGS for acute emergency management: Refer to the emergency department with sudden onset of any of the following:
* Headaches that worsen * Looks very drowsy/ can't be awakened * Can't recognize people or places * Neck pain
* Seizures * Repeated vomiting * Increasing confusion or irritability * Unusual behavioral change
* Focal neurologic signs * Slurred speech * Weakness or numbness in arms/legs * Change in state of consciousness

E. Diagnosis (ICD): __Concussion w/o LOC 850.0 __Concussion w/ LOC 850.1 __Concussion (Unspecified) 850.9 __Other (854) _____
__No diagnosis

F. Follow-Up Action Plan Complete *ACE Care Plan* and provide copy to patient/family.
___ No Follow-Up Needed
___ Physician/Clinician Office Monitoring: Date of next follow-up _____
___ Referral:
___ Neuropsychological Testing
___ Physician: Neurosurgery____ Neurology____ Sports Medicine____ Physiatrist____ Psychiatrist____ Other_____
___ Emergency Department

ACE Completed by:_____ MD RN NP PhD ATC

This form is part of the "Heads Up Brain Injury in Your Practice" tool kit developed by the Centers for Disease Control and Prevention (CDC).

Acute Concussion Evaluation (ACE)

Available as part of Physicians Tool Kit on CDC website

Management of Complex Concussion

- Consider referral to specialized provider or program if . . .
  - History of multiple concussions or other risk factors
  - Prolonged recovery (> 2 weeks)
  - Worsening symptoms

Treatment Strategies

- **Education and psychotherapy**

EARLY

- **Help patient understand injury and symptoms**
- **Prevent re-injury**
- **Avoid overexertion**
- **Reassurance about recovery**

LATE

- **Educate family, employer, teacher, coach, etc.**
- **Strategies to manage and cope with symptoms**
- **Address psychological issues complicating recovery (depression, PTSD, somatization)**
- **Identity, role, and meaning . . .**

Treatment Strategies

- **Medications**
  - Sleep disturbance
  - Headache
  - Irritability or mood swings
  - Fatigue and poor concentration
- **Physical & Occupational Therapy**
  - Neck & back problems
  - Balance (fall prevention)
  - Vision and Cognition

Treatment Strategies

- **Neuropsychological Testing**
  - Clarify cognitive and emotional status
  - Monitor recovery and guide treatment
  - Screen for symptom exaggeration
- **Refer for adjunctive treatments**
  - Vision (dry eye, photophobia)
  - Vestibular (ENT)
  - Psychiatric disorders
  - Pain

Concussion on Campus

- Students may not seek medical attention when needed
- Faculty and staff may not know student well enough to notice subtle symptoms
- Alcohol and drug use can increase risk of concussion and complicate recovery
- Disability services office can coordinate and advocate on behalf of student

Guidelines for Return to Class after Concussion

- Out of classes at first if necessary ('cognitive rest'), and then gradual re-entry as tolerated
- Focus on essential work that needs to be done (less mental energy available)
- Educate faculty and staff about injury and difficulties
- Provide academic accommodations

Academic Accommodations

- Reduced course and work load
- Extra time and a quiet location for tests
- Provide student with class notes or allow student to audiotape classes
- Preferential seating
- Rest breaks
- Minimize memorization
- Provide more structure and guidance on assignments

Return to Play

Prague 2004 guidelines recommend that when a player shows ANY symptoms or signs of a concussion:

- **athlete should not return-to-play in the current game or practice**
- **return-to-play must follow a medically supervised stepwise process**
- **athlete must be symptom-free at rest and after exertion**

when in doubt – sit 'em out !

Multiple Concussions

What are the risks ?

- **Second Impact Syndrome**
  - **A second concussion within a week of first**
  - **Rare but almost always fatal**
- **Increasing concussability**
- **Longer recovery**
- **Accumulating damage ?**
- **Problems can be subtle and hard to detect**
- **Possible lifelong symptoms and problems**

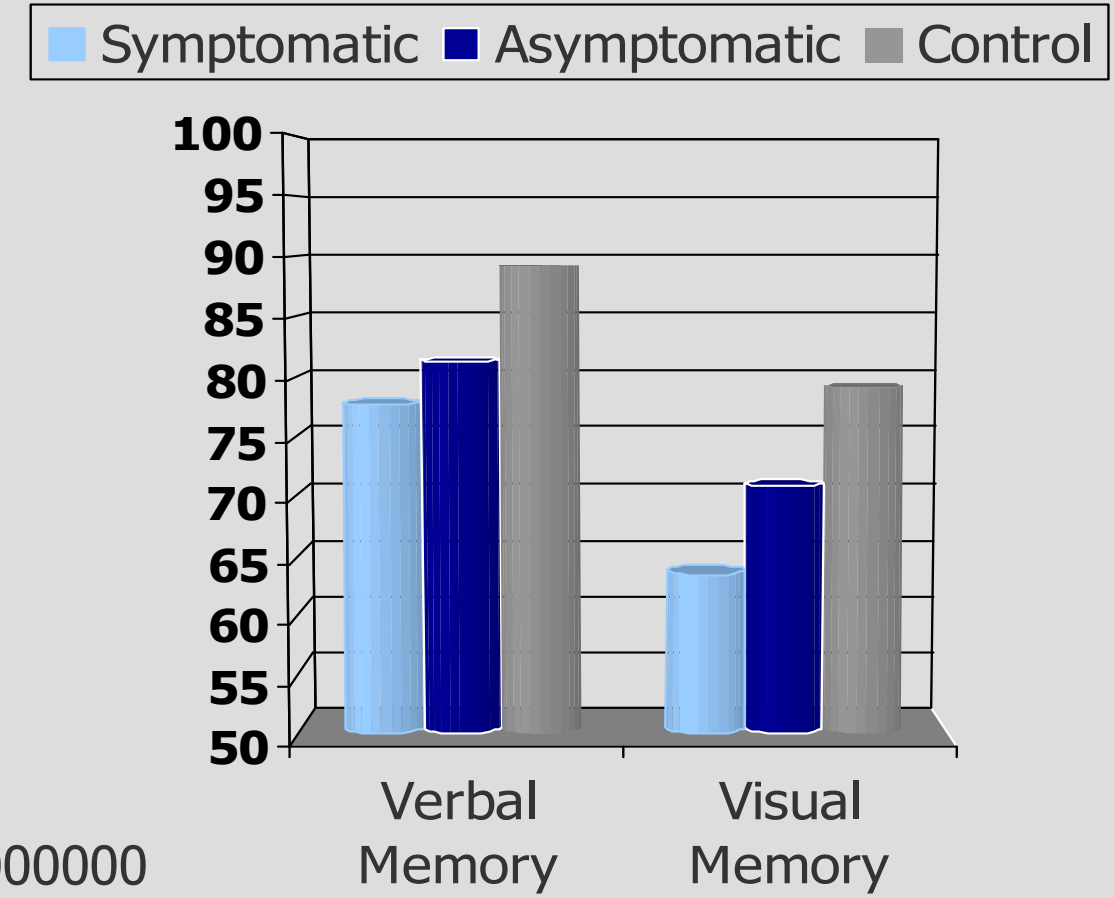
3 strikes and you're out ? Not necessarily . . .

Neuropsychological Testing In Sports Concussion

- Computerized tests that measure attention, memory, and processing speed (reaction time)
- Sensitive to effects of concussion
- Tests can be repeated multiple times to monitor recovery
- Ideally, pre-injury baseline testing done for all athletes
- ImPACT, CogSport, HeadMinder

Unique Contribution of Neurocognitive Testing to Concussion Management

Testing reveals cognitive deficits in asymptomatic athletes within 4 days post-concussion



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(Lovell et al., 2004)

New Developments

- Advances in imaging (fMRI, DTI, etc.)
- Increased understanding of neurometabolic disruption
- Helmet sensors and improvements
- DOD and VA spending on research
- Education intiatives
  - CDC
  - NYSPHSAA

Summary

- Concussion is a brain injury
- Symptoms usually resolve in 1 –2 weeks but can last longer
- Outcome complicated by pre- and post-injury factors (especially re-injury)
- Early recognition and education helps
- More research is needed to understand who is at risk for long-term problems and how to help them

Remember to wear your helmet !

riegerb@upstate.edu

Concussion Management Program & CNY Sports Concussion Center

University Hospital

Clinical Evaluation and Treatment

Community Education

Research

upstate.edu/concussion