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Traumatic Brain Injury

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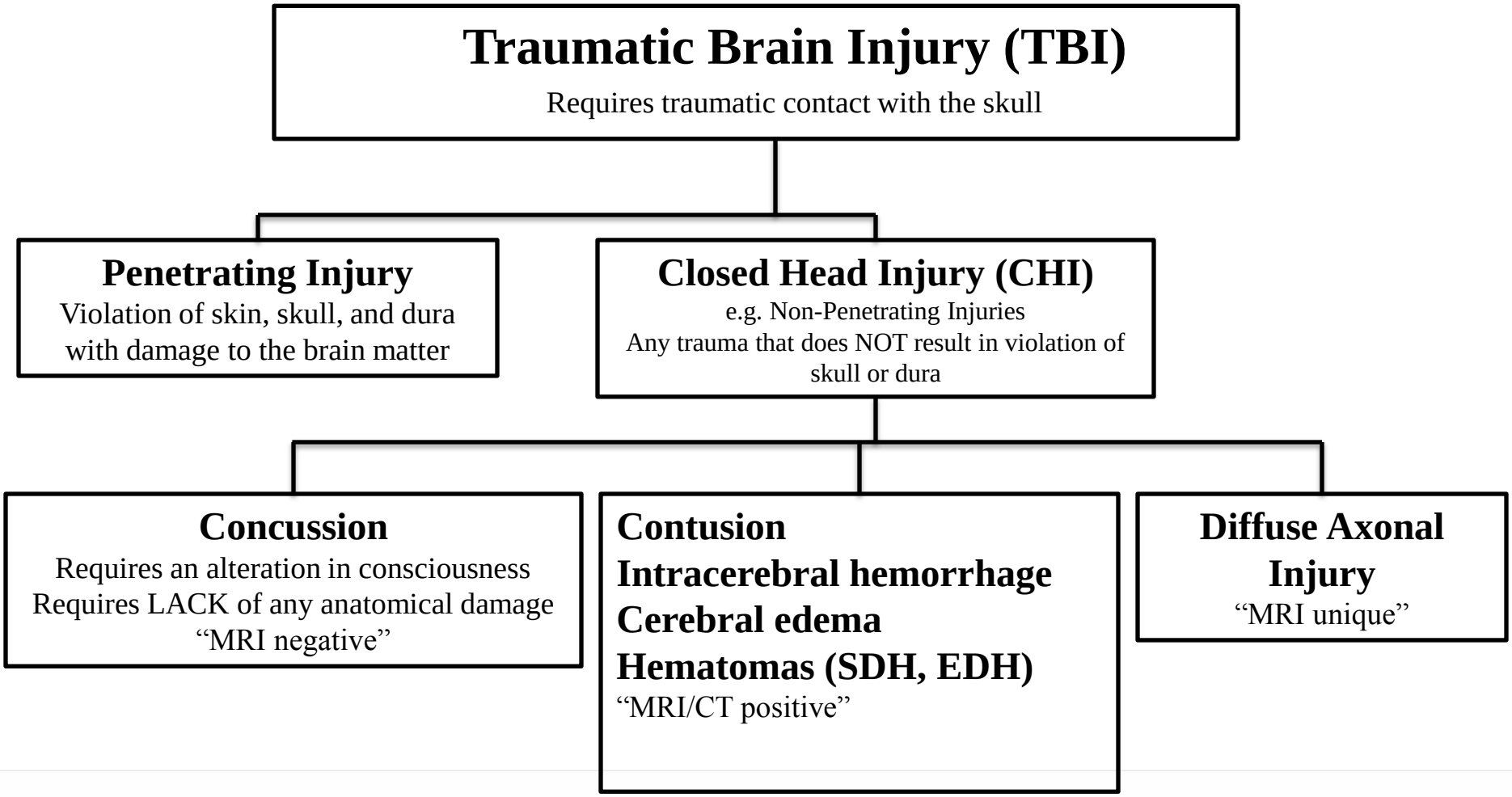
Disclosures

- About me…
- Full-time academic neurosurgeon with a research interest in TBI (concussion)
- Interested in neuroimaging markers of concussion
- Not getting paid for this talk

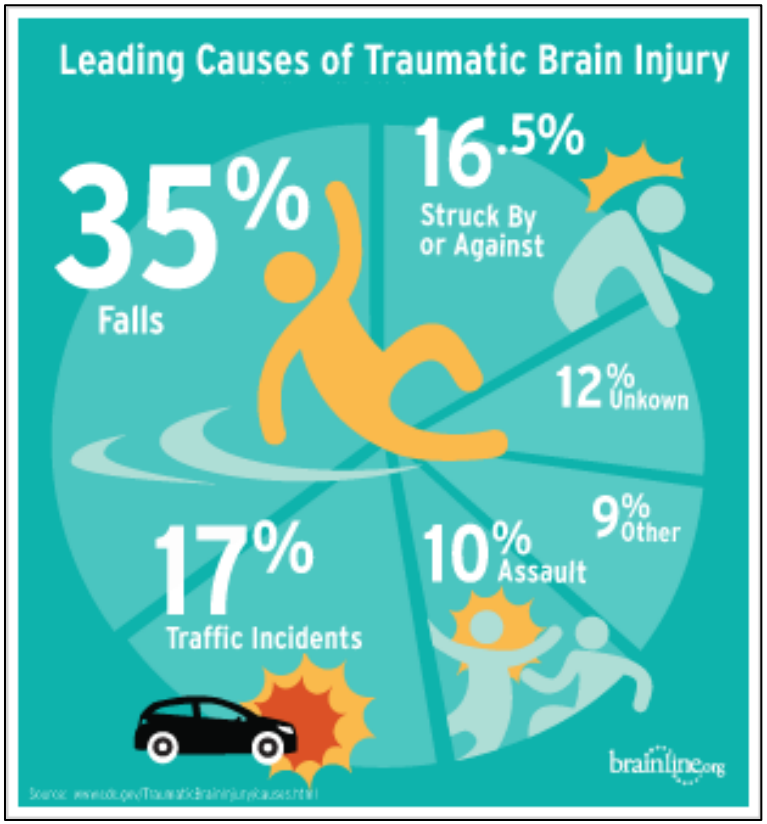
Objectives

- Define the various classifications of head injuries
- Discuss the differences between
  - Traumatic Brain injury (TBI)
  - Closed Head Injury (CHI)
  - Concussion (subtypes)
  - Post Concussion Syndrome
- Describe the diagnosis and management recommendations for various head injuries
- Discuss the prognosis of the head injured patient
- Discuss differences in outcomes of litigated vs non-litigated head injury patients


Traumatic Brain Injury (TBI)
Requires traumatic contact with the skull
Penetrating Injury
Violation of skin, skull, and dura with damage to the brain matter
Closed Head Injury (CHI)
e.g. Non-Penetrating Injuries
Any trauma that does NOT result in violation of skull or dura
Concussion
Requires an alteration in consciousness
Requires LACK of any anatomical damage
"MRI negative"
Contusion
Intracerebral hemorrhage
Cerebral edema
Hematomas (SDH, EDH)
"MRI/CT positive"
Diffuse Axonal Injury
"MRI unique"

Traumatic Brain Injury (TBI)

- Brain damage resulting from external forces, as a consequence of direct impact, rapid acceleration or deceleration, a penetrating object or blast waves from an explosion. The nature, intensity, direction and duration of these forces determine the pattern and extent of damage.
- Accounts for 35% of all brain damage deaths



MD, H. R. W. *Youmans Neurological Surgery,6e.* (Saunders, 2011)

Clinical Severity

- TBI can be classified based on clinical presentation

	GCS	PTA	LOC
Mild	13–15	<1 day	0–30 minutes
Moderate	9–12	>1 to <7 days	>30 min to <24 hours
Severe	3–8	>7 days	>24 hours

GCS = Glasgow coma scale, PTA = post traumatic amnesia, LOC = loss of consciousness

Glasgow Coma Scale

BEHAVIOR	RESPONSE	SCORE
Eye opening response	Spontaneously	4
	To speech	3
	To pain	2
	No response	1
Best verbal response	Oriented to time, place, and person	5
	Confused	4
	Inappropriate words	3
	Incomprehensible sounds	2
	No response	1
Best motor response	Obeys commands	6
	Moves to localized pain	5
	Flexion withdrawal from pain	4
	Abnormal flexion (decorticate)	3
	Abnormal extension (decerebrate)	2
	No response	1
Total score:	*Best response*	15
	Comatose client	8 or less
	Totally unresponsive	3

Department of Defense and Department of Veterans Affairs (2008). "Traumatic Brain Injury Task Force".

Penetrating Injuries

Closed Head Injury

- A mechanistic classification of TBI in which the skull and dura mater remain intact.

- Can be high or low impact mechanism of injury leading to mild, moderate or severe TBI
- It can result from rapid acceleration/deceleration or direct impact of brain against skull

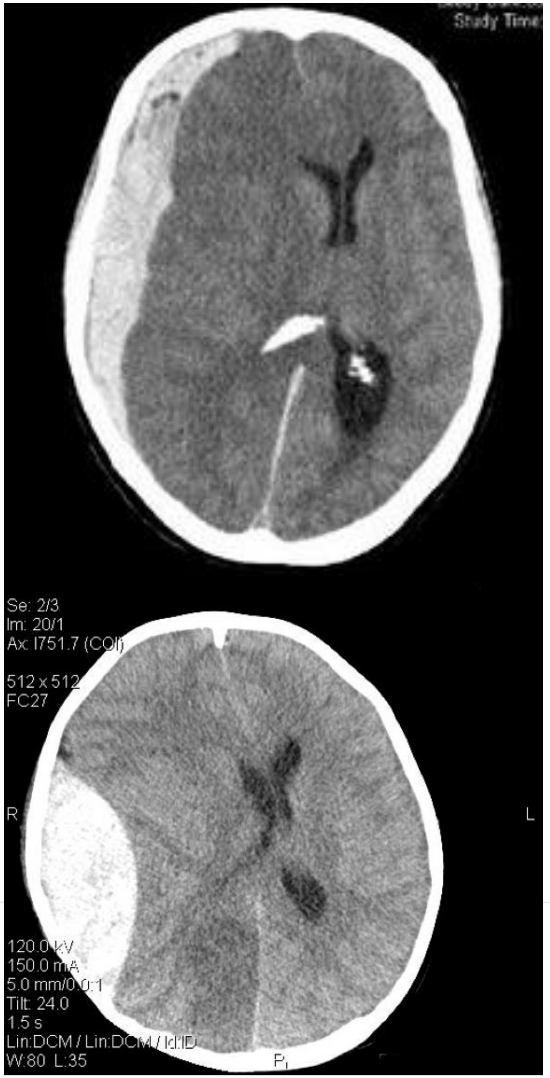
CHI – Contusion & ICH

- Often as a result of fall or altercation
- Contusion - Bruising of the brain
- ICH – Bleeding in the brain
- Most common location frontal and temporal lobes
- Long-term sequela:
  - Personality
  - Judgement
  - Impulse control
  - Location specific

SDH / EDH

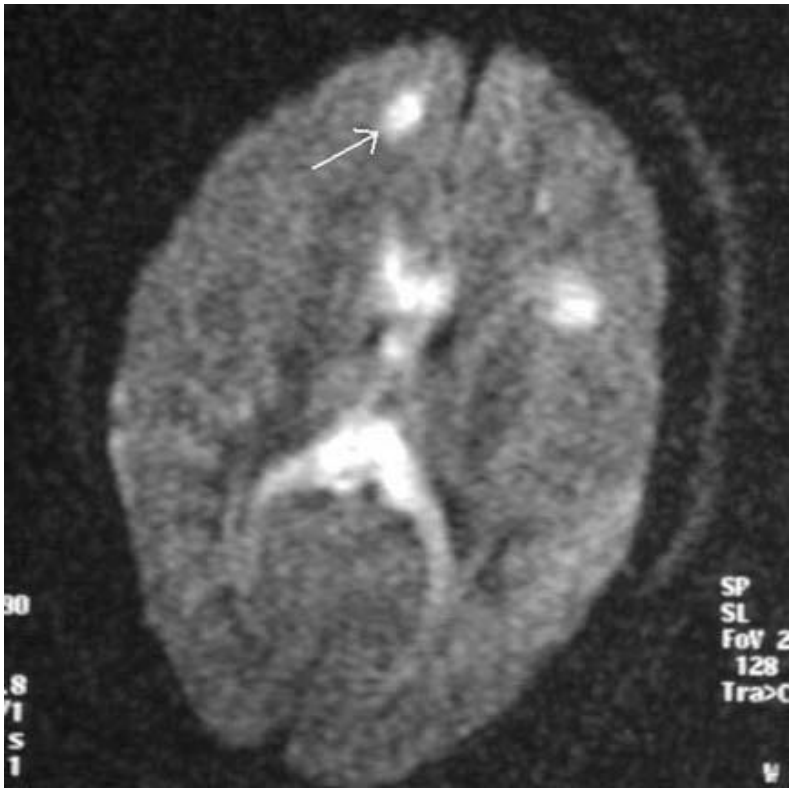
- SDH
  - Subdural hematoma
  - Tear in bridging vein
  - Prognosis guarded

- EDH
  - Epidural hematoma
  - Tear of MMA
  - High mortality
  - If you survive prognosis “ok”



Diffuse Axonal Injury (DAI)

- A primary lesion secondary to traumatic rotational acceleration/deceleration injury
- A common cause of persistent vegetative state and morbidity in TBI patients
- Diagnosed clinically when when LOC > 6 hours (or significant neurological decline) in absence of intracranial mass lesion or ischemia on CT



Wasserman J. and Koenigsberg R.A. (2007).

DAI Severity Scale

Grade	Pathology	Duration of Coma
I	Widespread axonal damage in white matter of cerebral hemispheres	Brief loss of consciousness
II	White matter axonal damage extending to the corpus callosum with tissue tear hemorrhages	Coma of duration; recovery process unclear
III	Pathology of Grade II diffuse axonal injury (DAI) with tissue tear hemorrhages in the brain stem	Immediate coma with posturing and incomplete recovery

Bay E, McLean SA: J Neurosci Nurs 2007 Feb;39:43–51

Concussion

- A form of mild TBI or CHI
- There is alteration of consciousness even if momentary immediately following the trauma
- Often with post-traumatic amnesia (PTA)
- Initial diagnosis made in ED
- Over & Under diagnosed
- NOTE: MRI and CT will be "normal"

Greenberg MS: Handbook of Neurosurgery. 7 edition Tampa, Fla, Thieme, 2010.

Concussion Signs/Symptoms

SIGNS OF INJURY

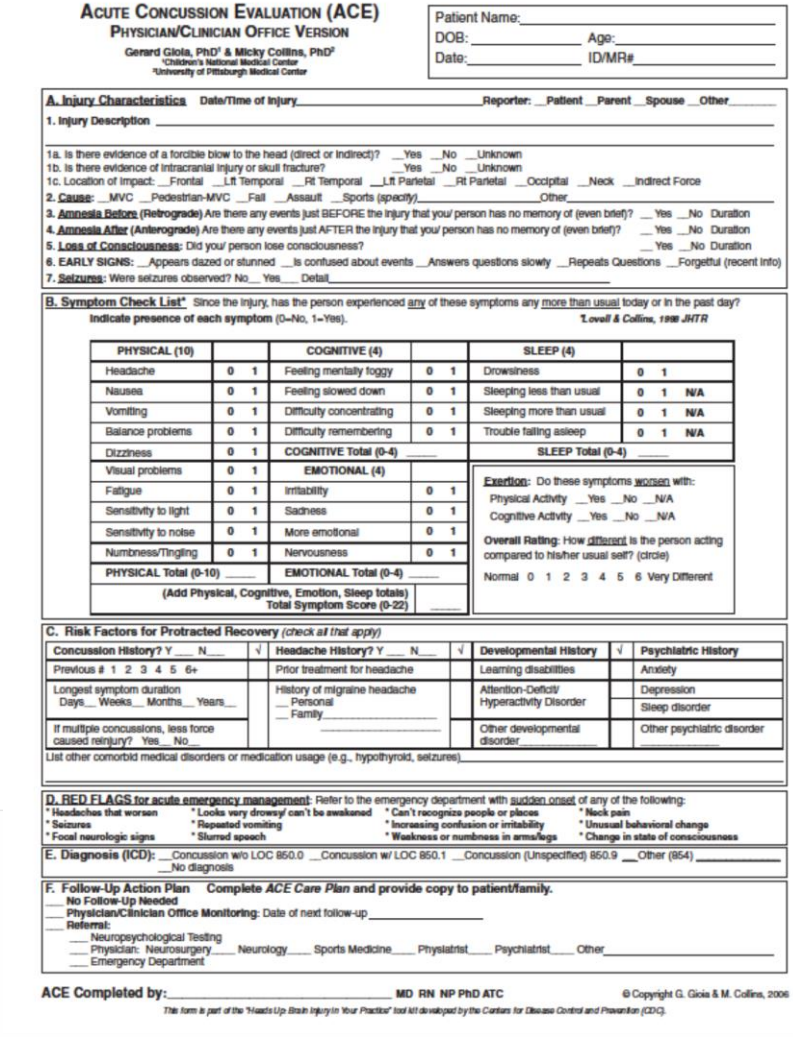
Loss of consciousness
Retrograde amnesia (forgetting events that happened before the concussion)
Anterograde or posttraumatic amnesia (forgetting events happening after the concussion)
"Dazed" look
Confusion about injury events or details
Disorientation to person, place, or time
Emotional lability
Inappropriate emotions
Behavior or personality changes

SYMPTOMS OF INJURY

Headache
Dizziness
Balance problems
Fatigue
Visual changes (double or blurry vision most common)
Insomnia
Hypersomnia
Drowsiness
Attentional dysfunction
Short-term memory and learning problems
Difficulty multitasking
Phonophobia
Photophobia
Bradyphrenia
Feeling mentally "foggy"
Emotional changes

MD, H. R. W. *Youmans Neurological Surgery,6e.* (Saunders, 2011)

Acute Concussion Evaluation



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).

A concussion (or mild traumatic brain injury (MTBI)) is a complex pathophysiologic process affecting the brain, induced by traumatic biomechanical forces secondary to direct or indirect forces to the head. Disturbance of brain function is related to neurometabolic dysfunction, rather than structural injury, and is typically associated with normal structural neuroimaging findings (i.e., CT scan, MRI). Concussion may or may not involve a loss of consciousness (LOC). Concussion results in a constellation of physical, cognitive, emotional, and sleep-related symptoms. Symptoms may last from several minutes to days, weeks, months or even longer in some cases.

ACE Instructions

The ACE is intended to provide an evidence-based clinical protocol to conduct an initial evaluation and diagnosis of patients (both children and adults) with known or suspected MTBI. The research evidence documenting the importance of these components in the evaluation of an MTBI is provided in the reference list.

A. Injury Characteristics:

1. Obtain **description of the injury** – how injury occurred, type of force, location on the head or body (if force transmitted to head). Different biomechanics of injury may result in differential symptom patterns (e.g., occipital blow may result in visual changes, balance difficulties).
2. Indicate the **cause of injury.** Greater forces associated with the trauma are likely to result in more severe presentation of symptoms.

3/4. **Amnesia:** Amnesia is defined as the failure to form new memories. Determine whether amnesia has occurred and attempt to determine length of time of memory dysfunction – before (retrograde) and after (anterograde) injury. Even seconds to minutes of memory loss can be predictive of outcome. Recent research has indicated that amnesia may be up to 4-10 times more predictive of symptoms and cognitive deficits following concussion than is LOC (less than 1 minute).[1]

5. **Loss of consciousness (LOC)** – If occurs, determine length of LOC.
6. **Early signs.** If present, ask the individuals who know the patient (parent, spouse, friend, etc) about specific signs of the concussion that may have been observed. These signs are typically observed early after the injury.
7. Inquire whether **seizures** were observed or not.

B. Symptom Checklist:[2]

1. Ask patient (and/or parent, if child) to report presence of the four categories of symptoms since injury. It is important to assess all listed symptoms as different parts of the brain control different functions. One or all symptoms may be present depending upon mechanisms of injury.[3] Record "1" for Yes or "0" for No for their presence or absence, respectively.
2. For all symptoms, indicate presence of symptoms as experienced within the past 24 hours. Since symptoms can be present premorbidly/at baseline (e.g., inattention, headaches, sleep, sadness), it is important to assess change from their usual presentation.
3. **Scoring:** Sum total number of symptoms present per area, and sum all four areas into Total Symptom Score (score range 0-22). (Note: most sleep symptoms are only applicable after a night has passed since the injury. Drowsiness may be present on the day of injury.) If symptoms are new and present, there is no lower limit symptom score. Any score > 0 indicates positive symptom history.
4. **Exertion:** Inquire whether any symptoms worsen with physical (e.g., running, climbing stairs, bike riding) and/or cognitive (e.g., academic studies, multi-tasking at work, reading or other tasks requiring focused concentration) exertion. Clinicians should be aware that symptoms will typically worsen or re-emerge with exertion, indicating incomplete recovery. Over-exertion may protract recovery.
5. **Overall Rating:** Determine how different the person is acting from their usual self. Circle "0" (Normal) to "6" (Very Different).

C. Risk Factors for Protracted Recovery: Assess the following risk factors as possible complicating factors in the recovery process.

1. **Concussion history:** Assess the number and date(s) of prior concussions, the duration of symptoms for each injury, and whether less biomechanical force resulted in re-injury. Research indicates that cognitive and symptom effects of concussion may be cumulative, especially if there is minimal duration of time between injuries and less biomechanical force results in subsequent concussion (which may indicate incomplete recovery from initial trauma).[4-8]
2. **Headache history:** Assess personal and/or family history of diagnosis/treatment for headaches. Research indicates headache (migraine in particular) can result in protracted recovery from concussion.[9-11]
3. **Developmental history:** Assess history of learning disabilities, Attention-Deficit/Hyperactivity Disorder or other developmental disorders. Research indicates that there is the possibility of a longer period of recovery with these conditions.[12]
4. **Psychiatric history:** Assess for history of depression/mood disorder, anxiety, and/or sleep disorder.[13-16]

D. Red Flags: The patient should be carefully observed over the first 24-48 hours for these serious signs. Red flags are to be assessed as possible signs of deteriorating neurological functioning. Any positive report should prompt strong consideration of referral for emergency medical evaluation (e.g. CT Scan to rule out intracranial bleed or other structural pathology).[17]

E. Diagnosis: The following ICD diagnostic codes may be applicable.

850.0 (Concussion, with no loss of consciousness) – Positive injury description with evidence of forcible direct/ indirect blow to the head (A1a); plus evidence of active symptoms (B) of any type and number related to the trauma (Total Symptom Score >0); no evidence of LOC (A5), skull fracture or intracranial injury (A1b).

850.1 (Concussion, with brief loss of consciousness < 1 hour) – Positive injury description with evidence of forcible direct/ indirect blow to the head (A1a); plus evidence of active symptoms (B) of any type and number related to the trauma (Total Symptom Score >0); positive evidence of LOC (A5), skull fracture or intracranial injury (A1b).

850.9 (Concussion, unspecified) – Positive injury description with evidence of forcible direct/ indirect blow to the head (A1a); plus evidence of active symptoms (B) of any type and number related to the trauma (Total Symptom Score >0); unclear/unknown injury details; unclear evidence of LOC (A5), no skull fracture or intracranial injury.

Other Diagnoses – If the patient presents with a positive injury description and associated symptoms, but additional evidence of intracranial injury (A 1b) such as from neuroimaging, a moderate TBI and the diagnostic category of 854 (Intracranial injury) should be considered.

F. Follow-Up Action Plan: Develop a follow-up plan of action for symptomatic patients. The physician/clinician may decide to (1) monitor the patient in the office or (2) refer them to a specialist. Serial evaluation of the concussion is critical as symptoms may resolve, worsen, or ebb and flow depending upon many factors (e.g., cognitive/physical exertion, comorbidities). Referral to a specialist can be particularly valuable to help manage certain aspects of the patient's condition. (Physician/Clinician should also complete the ACE Care Plan included in this tool kit.)

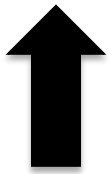
1. **Physician/Clinician serial monitoring** – Particularly appropriate if number and severity of symptoms are steadily decreasing over time and/or fully resolve within 3-5 days. If steady reduction is not evident, referral to a specialist is warranted.
2. **Referral to a specialist** – Appropriate if symptom reduction is not evident in 3-5 days, or sooner if symptom profile is concerning in type/severity.
   - Neuropsychological Testing can provide valuable information to help assess a patient's brain function and impairment and assist with treatment planning, such as return to play decisions.
   - Physician Evaluation is particularly relevant for medical evaluation and management of concussion. It is also critical for evaluating and managing focal neurologic, sensory, vestibular, and motor concerns. It may be useful for medication management (e.g., headaches, sleep disturbance, depression) if post-concussive problems persist.

Concussion Diagnosis

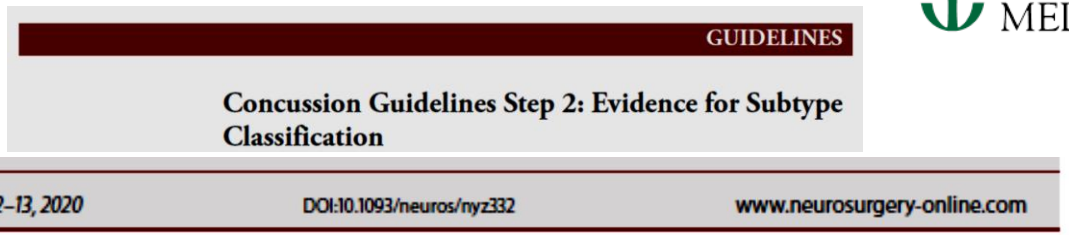
- Diagnosis is subjective and based on:
  - Mechanism of injury
  - LOC, alteration, and duration
  - Amnesia and duration
  - Signs
  - Symptoms

Concussion Grading Scales

Guidelines	Grade I	Grade II	Grade III
Cantu	Post-traumatic amnesia <30 minutes, no loss of consciousness	Loss of consciousness <5 minutes or amnesia lasting 30 minutes–24 hours	Loss of consciousness >5 minutes or amnesia >24 hours
Colorado Medical Society	Confusion, no loss of consciousness	Confusion, post-traumatic amnesia, no loss of consciousness	Any loss of consciousness
American Academy of Neurology	Confusion, symptoms last <15 minutes, no loss of consciousness	Symptoms last >15 minutes, no loss of consciousness	Loss of consciousness (IIIa, coma lasts seconds, IIIb for minutes)



Cantu RC. J Athl Train 2001;36:244–248.


GUIDELINES

Concussion Guidelines Step 2: Evidence for Subtype Classification

Neurosurgery 86:2–13, 2020 DOI:10.1093/neuros/nyz332 www.neurosurgery-online.com

- **Cognitive**
  - Impaired reaction time; speed of processing/performance; working memory; new learning; memory storage; memory retrieval; organization of thoughts. Demonstrated deficits in performance testing; cognitive symptoms ratings that are significantly greater than baseline levels;
- **Ocular-Motor**
  - Screen time, reading, driving; eye strain and eye fatigue; problems with visual focus including changing focus from near to far and back; photophobia; blurred vision or double vision; frontal headaches or eye pain/pressure behind the eyes; vision-derived nausea; difficulty judging distances; difficulty tolerating complex visual environments
  - Impairments may be detected by saccades, smooth pursuit, conjugate gaze, convergence, accommodation, and fixation assessments
- **Headache/Migraine**
  - Pre-existing headache types place individuals at greater risk for headache following a concussion or may be worsened following concussion with increasing frequency or severity. Patients with the headache/migraine subtype of concussion have self-reported history of headaches that differs from their pre-existing history
- **Vestibular**
  - Patients with the vestibular subtype have the following: at least 1 symptom of dizziness, fogginess, lightheadedness, nausea, vertigo, or disequilibrium; dysfunction in vestibuloocular or vestibulo-spinal tracts affecting gait and/or balance
- **Anxiety/Mood**
  - nervousness, feeling more emotional, hypervigilance, ruminative thoughts, feelings of being overwhelmed; depressed mood with sadness, feeling more emotional, anger, hostility/irritability, loss of energy, fatigue, and feelings of hopelessness

Associated

- Sleep disturbance
- Cervical Strain

Treatment of Acute Concussion

Grade I

- CT scan usually not indicated
- May be managed with observation at home if meet the following criteria
  - Initial GCS > 14
  - Presently neurologically intact
  - A responsible adult is able to observe patient
  - Patient has reasonable access to return to ED
  - No suspicion of "complicating" circumstances (e.g. domestic or child abuse)
  - Resolves in 24-48 hours

Grade II

- Non-contrast head CT indicated
- If head CT negative, patient may be observed at home if meets criteria for Grade I
- Usually resolves within 24-48 hours

Grade III

- STAT non-contrast head CT
- If head CT negative, patient observed for extended duration in ED or admitted for 24hr observation
- Re-evaluation by physician in 24 to 48 hours
- If no progression of symptoms, complete resolution is seen within 7 days in majority of cases

Concussion Prognosis

- The great majority of patients recover fully within 7 days
- If multiple symptoms persist greater than (7 days, 1 month, 3 months) the patient is diagnosed with post-concussion syndrome (PCS)
- Various studies site 5-30% of concussion patients developing PCS
- Significant difference between litigation and non-litigation patients
- Interestingly, the likelihood and severity of PCS is irrelevant of initial concussion severity
- NB: Difference between single and multiple concussions

Concussion Prognosis

- Best predictor of outcomes after TBI is :
- **DURATION OF PTA**
  - The longer the duration of PTA, the worse outcomes generally are.
  - Clinically, resolution of PTA occurs when patients are able to incorporate daily events into working memory.
  - Patients with PTA of less than 24 hours generally have a quick and full recovery with few exceptions, and patients with PTA of more than 4 weeks generally have permanent deficits.
  - Severe disability is unlikely with PTA of less than 2 months, and good recovery is unlikely when PTA is more than 3 months.

Money Matters: A Meta-Analytic Review of the Effects of Financial Incentives on Recovery After Closed-Head Injury

Laurence M. Binder, Ph.D., and Martin L. Rohling, Ph.D.

Objective: The authors evaluated the impact of financial incentives on disability, symptoms, and objective findings after closed-head injury. Method: Meta-analysis was used to review the literature. Seventeen reports, covering 18 study groups and a total of 2,353 subjects, contained data from which effect sizes could be calculated. Effect sizes were aggregated after weighting for group size. After discussion, there was 100% agreement between the authors on all calculations. Results: A moderate overall effect size, 0.47, was found. The effect was particularly strong for mild head trauma. The data showed more abnormality and disability in patients with financial incentives despite less severe injuries. Conclusions: Clinical evaluation of patients after closed-head injury, particularly mild head trauma, must include consideration of the effect of financial incentives on symptoms and disability.

(Am J Psychiatry 1996; 153:7–10)

Effect of Financial Incentive on Recovery after CHI

Meta-analysis based on 18 studies and 2353 subjects:

- Significant association between financial incentive and more disability after CHI
- Late onset symptoms were disproportionate among patients seeking compensation
- Patient seeking compensation had shorter duration of PTA.
- Patients who failed to return to work within 18 months were more likely to have short Pta (less than 1 Hr) than patients who had longer PTA.

Post Concussion Syndrome (PCS)

- Persistence of three or more symptoms of concussion after 7 days from original injury
- Most common
  - Headache
  - Fatigue
  - Vertigo
- Risk factors
  - Age > 40
  - Female
  - Pre-existing psychiatric diagnosis (depression, anxiety)
  - Psychosocial, secondary gain

Post Concussion Syndrome (PCS)

- Cognitive symptoms
  - Impaired concentration, short term memory and/or judgement
  - Can be objectively tested
- Somatic symptoms
  - Dizziness, blurred vision, balance difficulties, tinnitus
  - Can be objectively tested
- Psychosocial symptoms
  - Emotional lability, "feeling" depressed, personality changes, loss of libido, early fatigue
  - Subjective, cannot be tested

Greenberg MS: Handbook of Neurosurgery. 7 edition Tampa, Fla, Thieme, 2010.

PCS Treatment and Prognosis

- Treatment is symptom related as there is no catch all treatment for PCS. However:
  - **EARLY** neuropsychological assessment with testing is essential
  - MRI imaging to evaluate for organic cause
  - **EARLY** specialist referral (e.g. vestibular, cognitive, and physical rehabilitation for each symptom) is key
- Prognosis remains excellent – for "single" traumatic event (excludes sports with repeat injury)
- Full recovery within 3 months, sometimes as long as one year
- If symptoms persist or change, consideration should be given to alternative diagnosis
- Litigation and migraines independent risk factors for prolongation of recovery

Illustrative Case

- 60-year old male tripled over a rock and fell on concrete.
  - Landed on his knees, fell forward striking forehead
  - Dazed, had PTA for ~30min
  - In ER, no photophobia, nausea, vomiting, was coherent with GCS 15
  - 24 hour later – nausea, vomiting, headache, dizziness, insomnia, "dazed", "seeing patterns"
  - Concussion clinic evaluation (no personality or reliability measures)
    - RPQ-13 41 (Rivermead post-concussion symptoms questionnaire)
    - SAC 19 (Standardized Assessment of Concussion)
    - GAD 11 (Generalized Anxiety Disorder)
    - CES-D 23 (Center for Epidemiological Studies Depression)
  - Initial Vestibular assessment. Visual assessment

Illustrative Case Cont'd

- Cognitive/behavioral rest.
- Vestibular therapy – Objective measures
- Vestibular symptoms, nausea, vomiting, insomnia was 60-80% improved by four weeks
- Continued cognitive/behavioral rest.
- Six months persistent subjective STM memory loss and dizziness, headaches, and subjective cognitive slowing
- As such, formal neuropsychological assessment:

Neuropsychological Assessment

- Objective scores and subjective observations
- Looks for patterns and consistencies
- Good for detecting malingering, secondary gain
- Includes
  - Intellectual Functioning
  - Academic achievement
  - Visual processing and Motor Functioning
  - Attention and Excecutive Functioning
  - Social and Emotional
  - Memory
  - Effort
- Must provide guidance and direction on what you are looking for

Thank You!