Traumatic Brain Injury

Material Disclaimer

The material presented in this presentation is made available by the Texas Department of Insurance/Division of Workers' Compensation (TDI-DWC) for educational purposes only. The material is not intended to represent the sole approach, method, procedure or opinion appropriate for the medical situations discussed.

Traumatic Brain Injury

Traumatic Brain Injury (TBI):

- The current, specific terminology for a head injury event that results in dysfunction of the brain.
- Traumatic brain injuries can be caused by:
  - Direct trauma
  - An acceleration / deceleration (A/D) force to the head.
- ***Not ALL DIRECT TRAUMA OR A/D FORCES CAUSE A TBI!***

Traumatic Brain Injury

The American Congress of Rehabilitation Medicine provided a Position Statement for Traumatic Brain Injury (Menon et al 2010).

- This is defined as "***an alteration of brain function or other evidence of brain pathology caused by an external force"*.**
- There are associated specific clinical findings of **alteration of brain function.**

Menon DK, Schwab K, Wright DW, Maas AI; Demographics and Clinical Assessment Working Group of the International and Interagency Initiative toward Common Data Elements for Research on Traumatic Brain Injury and Psychological Health. Position statement: definition of traumatic brain injury. Arch Phys Med Rehabil. 2010 Nov;91(11):1637-40.

Traumatic Brain Injury

ACRM Position Statement for TBI

The clinical findings of alteration of brain function entail:

1. Any period of loss of or decreased consciousness,
2. Any loss of memory for events immediately before (retrograde amnesia) or after the injury (post traumatic amnesia),
3. Any alteration in mental state at the time of the injury (confusion, disorientation, slow thinking etc.),
4. Neurologic deficits (weakness, loss of balance, change in vision, dyspraxia, paresis / plegia, sensory loss, aphasia etc.)"

Traumatic Brain Injury

One basic criteria of GRADING / STATIFICATION methods of a TBI is as per the Glasgow Coma Scale (GCS) at presentation of the injury up to the first 24 hours.

- MILD TBI (mTBI):
  - Initial GCS of 13 -15.

    The majority of TBIs fall in this category and are the concussions.
- MODERATE TBI:
  - Initial GCS of 9-12
- SEVERE TBI:
  - Initial GCS 3 – 8.

Traumatic Brain Injury

- In addition to the Glasgow Coma Scale (GCS) at presentation of the injury to the first 24 hours.
- **Other Criteria are:**
  - Loss of Consciousness (LOC)
  - Alteration of Consciousness (AOC)
  - Presence of Post-Traumatic Amnesia (PTA)
  - Imaging Findings *

* ***If all other criteria indicate a MILD TBI, but there are + imaging findings, this can be considered a "complicated" Mild TBI***

Traumatic Brain Injury

CLINICAL CRITERIA for TBI

Criteria	MILD	MODERATE	SEVERE
Structural imaging	Definition Dependent ***	Normal or abnormal	Normal or abnormal
Loss of consciousness (LOC)	0-30 minutes	> 30 min and < 24 hrs	> 24hrs
Alteration of consciousness (AOC)**	A moment up to 24 hours **	> 24 hours. Severity is based on other criteria	
Post Traumatic amnesia (PTA)	0-1 day	> 1 and < 7 days	> 7 days
GCS (best score in first 24 hours)	13-15	9-12	< 9

** and ** on next slide*

Traumatic Brain Injury

- Patients who otherwise meet the clinical criteria for mTBI but have **intracranial imaging abnormalities** may be classified as complicated mTBI or moderate TBI depending on the definition used.
- **Alteration of mental status must be immediately related to the trauma to the head.**
  - Typical symptoms may include looking or feeling dazed, confusion, difficulty thinking clearly or responding appropriately to mental status questions, or inability to describe events immediately before or after the traumatic event.

Adapted from: IOM (Institute of Medicine). Gulf War and Health, Volume 7: Long-term Consequences of Traumatic Brain Injury. Washington, D.C.: The National Academies Press; 2009.

Traumatic Brain Injury

An estimated 80 – 90 % of TBIs are considered mild and in the form of a **concussion** (mTBI).

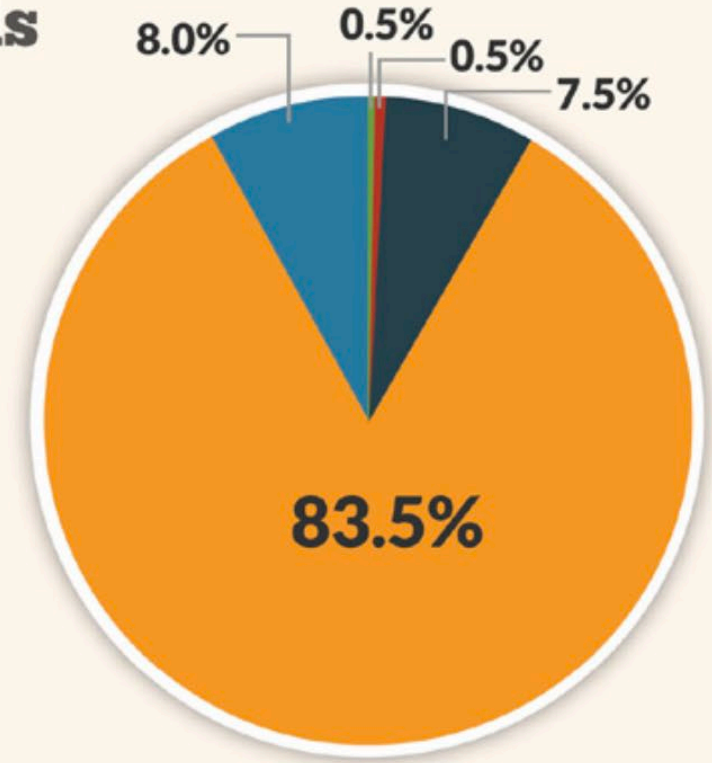
- Concussions (usually) demonstrate no visible anatomic disruption on imaging of the brain.
- If they do, they may be considered "complicated" mTBI.
- There are likely metabolic and cellular responses to either direct trauma (DT) or an acceleration / deceleration (AD) event that cause the initial symptoms.

Traumatic Brain Injury

DoD Numbers for Traumatic Brain Injury
Worldwide – Totals

2014 (Q1 - Q3)

Penetrating	100
Severe	86
Moderate	1,384
Mild	15,501
Not Classifiable	1,493
Total - All Severities	**18,564**



Source: Defense Medical Surveillance System (DMSS), Theater Medical Data Store (TMDS) provided by the Armed Forces Health Surveillance Center (AFHSC)

Prepared by the Defense and Veterans Brain Injury Center (DVBIC)

2014 (Q1 - Q3), as of Dec 1, 2014

Department of Defense from 2014

Traumatic Brain Injury

Concussion:

- If there is a concussion, there should be Immediate temporary disruption of neurologic function by one of the criteria discussed.
- Delayed onset headache or other concussion symptoms OR addition of more symptoms over time in delayed onset from the injury event are NOT due to a concussion

Traumatic Brain Injury

Concussion

POTENTIAL ACUTE PHASE symptoms may include:

1. Physical Symptoms
2. Cognitive Symptoms
3. Emotional / behavioral symptoms

Traumatic Brain Injury

POTENTIAL ACUTE PHASE symptoms

1. PHYSICAL:

- Headache
- Nausea / Vomiting
- Dizziness, Balance difficulties
- Ringing in the ears / Tinnitus, Loss of hearing
- Double vision / Blurred vision, Lowered tolerance for light / Photophobia
- Lowered tolerance for noise / Phonophobia
- Insomnia,
- Fatigue / Lethargy

Traumatic Brain Injury

POTENTIAL ACUTE PHASE symptoms

2. COGNITIVE:
   - Confusion
   - Impaired memory
   - Difficulty concentrating
   - Distractibility,
3. EMOTIONAL / BEHAVIORAL:
   - Irritability
   - Anxiety
   - Depressive symptoms

Traumatic Brain Injury

POTENTIAL ACUTE PHASE symptoms:

The reason for the caveat of POTENTIAL is that **"COMMON THINGS HAPPEN COMMONLY"**

- **Other causes of perceived physical, cognitive and emotional symptoms:**
  - ✓ **Other injury related factors (injuries to areas other than the head)**
  - ✓ **Other medical causes**
  - ✓ **Non-injury related psychobehavioral factors**

Traumatic Brain Injury

CHALLANGES TO DIAGNOSING A CONCUSSION (and therefore determining MMI and any residual impairment if any):

- The subjective nature of concussion-related symptoms,
- The low specificity of the symptoms to concussion,
- The significant overlap with other physical, neurological, and psychiatric conditions

Polinder S, Cnossen MC, Real RGL, Covic A, Gorbunova A, Voormolen DC, Master CL, Haagsma JA, Diaz-Arrastia R, von Steinbuechel N. A Multidimensional Approach to Post-concussion Symptoms in Mild Traumatic Brain Injury. Front Neurol. 2018 Dec 19;9:1113.

Traumatic Brain Injury

Common things happen commonly....

MISATTRIBUTION OF SYMPTOMS

- Symptoms such as headache, irritability, sleep disturbance and forgetfulness may be misattributed to brain trauma (Evans, and Hou et al)

#Evans RW. Persistent post-traumatic headache, post concussion syndrome, and whiplash injuries: the evidence for a non-traumatic basis with an historical review. Headache (2010) 50:716–24. 10.1111/j.1526-4610.2010.01645.x

#Hou R, Moss-Morris R, Peveler R, Mogg K, Bradley BP, Belli A. When a minor head injury results in enduring symptoms: a prospective investigation of risk factors for post concessional syndrome after mild traumatic brain injury. J Neurol Neurosurg Psychiatry (2012) 83:217–23. 10.1136/jnnp-2011-300767

Traumatic Brain Injury

Common things happen commonly....

MISREMEMBERING

The “good-old-days” bias may lead some to underestimate pre-injury symptoms

(Silverberg, Iverson, and Lange, Iverson et al.)

#Silverberg ND, Iverson GL. Etiology of the post-concussion syndrome: physiogenesis and psychogenesis revisited.

NeuroRehabilitation (2011) 29:317–29. 10.3233/NRE-2011-0708

#Lange RT, Iverson GL, Rose A. Post-concussion symptom reporting and the “good-old-days” bias following mild traumatic brain injury. Arch Clin Neuropsychol. (2010) 25:442–50. 10.1093/arclin/acq031

Traumatic Brain Injury

Common things happen commonly....

EXPECTATIONS

Patients after mTBI expecting to experience post-concussion symptoms show higher symptom rates than patients not expecting to experience post-concussion symptoms. (Snell et al)

Snell DL, Surgenor LJ, Hay-Smith EJC, Williman J, Siegert RJ. ***The contribution of psychological factors to recovery after mild traumatic brain injury: is cluster analysis a useful approach?*** *Brain Injury (2015) 29:291–9. 10.3109/02699052.2014.976594*

Traumatic Brain Injury

Common things happen commonly....

- The good news is that most individuals with a true concussion event have a favorable prognosis.
- Important that the treating providers offer encouragement and expectation that they will recover.
    - ❖ Consequences of not doing so are prolonged recovery and disability

Traumatic Brain Injury

Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5)

- *"Neurobehavioral symptoms tend to be the most severe in the time frame immediately after the TBI".*
- ***"Except in cases of severe TBI, the typical course is complete or substantial improvement in associated neurocognitive, neurological and psychiatric symptoms and signs".***

Traumatic Brain Injury

- As per the DSM-5, "***Neurocognitive symptoms associated with mild TBI tend to resolve within days to weeks after the injury with complete resolution typical by 3 months".***

American Psychiatric Association (APA). ***The Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition, DSM-5,*** *2013.*

Traumatic Brain Injury

- The Department of Defense (DOD) / Veterans Affairs (VA) also asserts that most individuals who have sustained a concussion form of mTBI improve with no lasting clinical sequelae.

- The DSM-5 AND the DOD / VA consensus is consistent with the EBM literature that in most individuals, the effects of a true concussion event resolve within 3 months and have no lasting neuro-cognitive-behavioral sequalae.

Traumatic Brain Injury

- As per Levin et al, ***"the data suggest that a single uncomplicated minor head injury produces no permanent disabling neurobehavioral impairment in the great majority of patients who are free of preexisting neuropsychiatric disorder and substance abuse".***

Levin HS, Diaz-Arrastia RR. Diagnosis, prognosis, and clinical management of mild traumatic brain injury. Lancet Neurol. 2015 May;14(5):506-17. doi: 10.1016/S1474-4422(15)00002-2. Epub 2015 Mar 20. PMID: 25801547.

Traumatic Brain Injury

Post-Concussion Syndrome (PCS)

- Medical term and an ICD1-10 diagnosis .
- Misunderstood and misused term by ***most*** physicians.
- The initial symptoms in the first 3 months after a true concussion event are the concussion.
- When the symptoms much less commonly continue after 3 months it is called **"post-concussion syndrome".**

Traumatic Brain Injury

Post-Concussion Syndrome (PCS)

- This term is NOT used by the DSM-5 for good reason
- The "syndrome" of PCS has largely been debunked by the scientific community
- As discussed, most of the ***symptoms*** associated with a concussion are common and can be present in individuals with injuries not to the head and in the uninjured population. **[More later.]**

Traumatic Brain Injury

- When symptoms persist beyond the 3 months after a valid concussion event, the SYMPTOMS are more probable to be due to another disorder, so there is considerable risk of misdiagnosis of a collection of symptoms as being due to post-concussion syndrome.
- **Causes for persistent symptoms after an injury to the head:**
  - Organic / real (uncommon but may occur)
  - Psychological factors or psychiatric disorders
  - Non-injury related factors

Traumatic Brain Injury

Post-Concussion Syndrome

- As per Ryan, ***"a variety of pre-morbid, injury-related, and post-morbid neuropathological and psychological factors contribute to the development and continuation of these symptoms in those sustaining mild traumatic brain injury (MTBI)".***

Ryan LM, Warden DL (2003). Post-concussion Syndrome. International Review of Psychiatry 15 (4): 310–6.

Traumatic Brain Injury

Post-Concussion Syndrome

- As per Dwyer et al, among others, this phase after the first 3 months is ***"highly influenced by various psychosocial factors and is much less specific to the brain injury itself".***

Dwyer B, Katz DI. Postconcussion syndrome. Handb Clin Neurol. 2018;158:163-178. doi: 10.1016/B978-0-444-63954-7.00017-3. PMID: 30482344.

Traumatic Brain Injury

IF there is an uncomplicated mTBI, persistent symptoms and poor functional outcomes are often associated with non-injury related variables including:

1. Demographic,
2. Psychosocial,
3. Medical,
4. Motivational
5. Other situational factors.

McCrea, MA (2008). Mild Traumatic Brain Injury and Post-concussion Syndrome: The New Evidence Base for Diagnosis and Treatment. American Academy of Clinical Neuropsychology. Oxford University Press.

Traumatic Brain Injury

Concussion

- When symptoms are persistent at > 3 months, risk factors due to a concussion (organic cause rather than psychosocial factors) are:
  - High, **early** symptom burden
  - A history of multiple concussions,
  - Longer duration of unconsciousness or amnesia.
  - Younger age.

Traumatic Brain Injury

- The study by Kashluba et al *"examined the role of factors identified by the World Health Organization's Task Force on Mild Traumatic Brain Injury as being associated with poor outcome after mild traumatic brain injury".*
- Findings revealed that ***"individuals who report greater symptom complaints at 3 months post-MTBI may be identifiable soon after injury on the basis of the magnitude and severity of early self-reported symptoms, pre-morbid psychological issues, and involvement in compensation-seeking. Injury severity factors did not differ between the groups".***
- **Kashluba S, Paniak C, Casey JE. Persistent Symptoms Associated with Factors Identified by the WHO Task Force on Mild Traumatic Brain Injury. *The Clinical Neuropsychologist,* 22: 195-208. 2008. PMID: 17853135.**

Traumatic Brain Injury

Post-Concussion Syndrome

A study by Dean et al,

"Persistent PCS symptoms at one year were present to a similar extent in participants with no head injury (34% of controls) compared to those with mTBI (31%)."

Dean PJ, O'Neill D, Sterr A. ***Post-concussion Syndrome: Prevalence After Mild Traumatic Brain Injury in Comparison with a Sample Without Head Injury.*** *Brain Inj. 2012;26(1):14-26.*

Traumatic Brain Injury

In a study by Wang et al, healthy university students reported ***"a relatively high base rate of postconcussion-like symptoms"***.

- Most frequently endorsed were "fatigue" (76.9%), "longer time to think" (60.3%), "poor concentration" (58.7%), "sleep disturbance" (50.4%), and "frustration" (46.3%).
- These symptoms had no relationship to injury or neuropsychological function.

Wang Y, Chan RCK, Deng Y. ***Examination of postconcussion-like symptoms in healthy university students: Relationship to Subjective and objective neuropsychological performance.*** *Archives of Clinical Neuropsychology 21 (2006) 339-347.*

Traumatic Brain Injury

In the Meta-analysis by Belanger et al, of possible residual neuropsychological deficits:

- Despite acute effects, "*In unselected or prospective samples, the overall analysis revealed no residual neuropsychological impairment by 3 months postinjury*"
- *"In contrast, clinic-based samples **and** samples including participants in litigation were associated with greater cognitive sequelae of MTBI".*

Traumatic Brain Injury

- They also found that ***"litigation was associated with stable or worsening of cognitive functioning over time"***, rather than improving over time.

Belanger HG, Curtiss G, Demery JA, Lebowitz, BK, Vanderploeg, R. D. Following Mild Traumatic Brain Injury: A Meta-Analysis. J Int Neuropsychol Soc. 2005 May;11(3):215-27.

Traumatic Brain Injury

Many other general medical conditions can cause neuro cognitive dysfunction UNRELATED to a potential TBI event.

- **These cannot be considered as an alternate explanation to a symptom complex, unless you as the DD ask additional historical questions**
- **Don't assume the neuropsychologist you refer to:**
  - **Will ask these questions**
  - **Review the medical records**

Traumatic Brain Injury

Additional historical questions:

- Developmental history:
  - Premature birth, developmental delay
  - Learning disorders - dysgraphia, dyslexia, Asperger's spectrum, ADD/ADHD
- Drug and Alcohol use (past and current)
- Psychologic Disorders (more on this later)
- General Medical History (only a few potential issues)

  # Obesity. # Obstructive Sleep Apnea (OSA)

  # Migraines. # Low Vit D

Traumatic Brain Injury

Additional historical questions:

- **General Medical History –** Obstructive Sleep Apnea (OSA)
- OSA very common in the general population
- OSA-related hypoxemia changes the structure and function of blood vessels, including in the brain, adversely affecting cognition.
- Meta-analysis by Aloia et al, "*the primary daytime sequelae of the disorder include ...depression, and attention and concentration problems.*"

Aloia MS, Arnedt JT, Davis JD, Riggs RL, Byrd D. Neuropsychological sequelae of obstructive sleep apnea-hypopnea syndrome: a critical review. J Int Neuropsychol Soc. 2004 Sep;10(5):772-85. doi: 10.1017/S1355617704105134. PMID: 15327723.

Traumatic Brain Injury

Additional historical questions:

General Medical History – OSA

- Meta-analysis by Stranks and Crowe
  - Deficits in *"Attention/ vigilance dysfunction appears to be associated with sleep fragmentation and global cognitive function with hypoxemia".*
  - There were also *"deficits in delayed long-term visual and verbal memory, visuospatial / constructional abilities, and executive function in individuals with OSA".*

Stranks, EK, Crowe SF. The Cognitive Effects of Obstructive Sleep Apnea: An updated Meta-Analysis.. Archives of Clinical Neuropsychology 31 (2016) 186-193.

Traumatic Brain Injury

General Medical History – Migraines

- The meta-analysis by Gu and Wang et al demonstrated lower general cognitive function and language function in migraine.
  - Associated with an increased risk of all cause dementia, vascular dementia (VaD) and Alzheimer's disease (AD).

Gu, L., Wang, Y. & Shu, H. Association between migraine and cognitive impairment. *J Headache Pain* **23**, 88 (2022). https://doi.org/10.1186/s10194-022-01462-4

Traumatic Brain Injury

General Medical History – Vit D Deficiency

- Is very common; a body mass index > 30 associated with lower vitamin D levels. Fat cells sequester Vit D, so it is not available to the rest of the body.
- Causes calcium deficiency and altered bone health
- Non-skeletal symptoms are
- Chronic fatigue,
- Muscle weakness / cramping
- Depression, neurologic and memory function

Zhang S, Miller DD Lei, W. Non-Musculoskeletal Benefits of Vitamin D beyond the Musculoskeletal System. Int. J. Mol. Sci. 2021, 22, 2128. https://doi.org/10.3390/ijms22042128

Traumatic Brain Injury

- As per Larabee et al, *"the more common potential concussive symptoms like headache, dizziness, and sleep problems related by individuals that have had a concussion or are diagnosed with a concussion are also similar to those often experienced by individuals diagnosed with other psychological disorders".*

Larrabee GL, Binder LM, Rohling ML, Ploetz DM. Meta-analytic Methods and the Importance of non-TBI Factors Related to Outcome in Mild Traumatic Brain Injury: Response to Bigler Et Al. (2013). Clinical Neuropsychol. 2013;27(2):215-37.

Traumatic Brain Injury

The psychological disorders with considerable overlap to concussion symptoms include:

- Major Depressive Disorder (MDD),
- ANY Anxiety Disorder,
- Post-Traumatic Stress Disorder
- Somatic Symptom Disorder (SSD) or related Somatoform Disorders *

Larrabee et al.

Traumatic Brain Injury

Somatic Symptom Disorder / Somatoform disorders

- A group of psychiatric disorders that result in unexplained physical symptoms.
- This class of disorders is characterlogic and not a condition that develops as a result of a life event.
- Rather, the life event is perceived and expressed differently when one of this disorders is present, than in those without these disorders.

Traumatic Brain Injury

Somatoform disorders

- Individuals that have real injuries can still have a somatoform disorder
- Those that do not meet the strict psychiatric diagnostic criteria (DSM-5) for a somatoform disorder, can be said to have "*somatic preoccupation*".

#Barsky AJ, Borus JF. Somatization and medicalization in the era of managed care. JAMA. 1995;274:1931-4.

#de Waal MW, Arnold IA, Eekhof JA, van Hemert AM. ***Somatoform disorders in general practice: prevalence, functional impairment and comorbidity with anxiety and depressive disorders.*** *Br J Psychiatry. 2004;184:470-6.*

Traumatic Brain Injury

- **Somatization:** A process where physical symptoms are disproportionate to an identifiable physical disease.

- **Related to this are:**

❖ Functional Somatic Syndromes

❖ Medically Unexplainable Physical Symptoms (MUPS)

Traumatic Brain Injury

- **Functional Somatic Syndromes (FSS): "*syndromes characterized more by symptoms, suffering, and disability than by consistently demonstrable tissue abnormality.*"**

Barsky AJ, Borus, JS. Functional Somatic syndromes. June 1999. Annals of Internal Medicine 130(11):910-912.

- **Medically Unexplainable Physical Symptoms (MUPS):*"a disturbance of normal neurological and/or psychological processes underlying symptom production, perception, and experience and cannot be better explained by another physical or psychiatric illness."***

Caruso G, Kertay L, Psychological Factors in Delayed and Failed Recovery and Unnecessary Disability, AMA Guides Newsletter, May/June 2019

Traumatic Brain Injury

Medically Unexplainable Physical Symptoms (MUPS):

- Kirmeyer et al found in a community survey of 2400 people, 10.5% reported at least 1 medically unexplained symptom in the past year.
- The most common unexplained symptoms were musculoskeletal pain, ear, nose, and throat symptoms, abdominal pain and gastrointestinal symptoms, fatigue, and dizziness.

Kirmayer, LJ, Groleau D, Looper KJ, Dao MD. Explaining Medically Unexplained Symptoms. The Canadian Journal of Psychiatry, 2004 Oct;49(10):663-72.

Traumatic Brain Injury

Medically Unexplainable Physical Symptoms (MUPS):

- Individuals with medically unexplained symptoms comprise from 15% to 30% of all primary care consultations.

Kirmayer, LJ, Groleau D, Looper KJ, Dao MD. Explaining Medically Unexplained Symptoms. The Canadian Journal of Psychiatry, 2004 Oct;49(10):663-72.

- MUPS are very common, comprising up to half of all consultations in primary care and up to one third of those in hospital outpatient clinics.

Stephenson DT, Price JR. Medically unexplained physical symptoms in emergency medicine. Emerg Med J. 2006;23(8):595–600. doi:10.1136/emj.2005.032854

Traumatic Brain Injury

- As per Silver, ***"although most individuals who suffer a mild traumatic brain injury have complete recovery, a number experience persistent symptoms that appear inconsistent with the severity of the injury".***

- *Silver JM.* ***Effort, exaggeration and malingering after concussion.*** *J Neurol Neurosurg Psychiatry 2012; 83:836–841.*

Traumatic Brain Injury

Silver (continued)

- When there are individuals that experience persistent symptoms that are inconsistent with the severity of the injury, persistent symptoms may be attributed to:
  - Exaggeration or poor effort on cognitive testing
  - Other subconscious behavioral processes
  - Malingering,
- ***"Symptom magnification or poor effort are complex and multi-determined behaviors with a unique differential diagnosis which have important implications for research, evaluation and treatment."***

Traumatic Brain Injury

In a study by Tsandis et al, a group with mild TBI and poor effort on neuropsychological testing reported more symptoms and **with greater severity** than a group with bona fide moderate to severe TBI

Tsanadis J, Montoya, E, Hanks RA, Millis SR, Fitchenberg NL, Axelrod BN. Brain injury severity, litigation status, and self-report of postconcussive symptoms. The Clinical Neuropsychologist. Volume 22, 2008 – Issue 6, pages 1080 – 1092.

Traumatic Brain Injury

- Compensation and litigation can offer complex subconscious motivators (primary, secondary and tertiary gain) and conscious motivators.
- The individual with subconscious motivators is not aware how the “injury” is used to express their emotional symptoms or psychological needs.
- Even those with an actual injury are not immune to embellishment by subconscious secondary gain OR conscious deception (malingering).

Traumatic Brain Injury

The review by Polinder et al concluded, ***"Post-concussion symptoms are highly controversial and a major topic of debate among clinicians, methodologists, and health outcome experts".***

- Post-concussion symptoms do not always cluster in a consistent and predictable manner
- Controversial whether they truly represent a specific, cohesive, and predictable syndrome (i.e., PCS)

Polinder S, Cnossen MC, Real RGL, Covic A, Gorbunova A, Voormolen DC, Master CL, Haagsma JA, Diaz-Arrastia R, von Steinbuechel N. A Multidimensional Approach to Post-concussion Symptoms in Mild Traumatic Brain Injury. Front Neurol. 2018 Dec 19;9:1113.

Traumatic Brain Injury

As per Poliner et al,

"Although the term post-concussion symptoms might suggest otherwise, these symptoms are ***not specific*** *to TBI but are also frequently reported in*

- *non-brain injured trauma patients (Cassidy et al),*
- *patients with whiplash injuries (Marshall et al)*
- *healthy adults and children (Iverson et al and Wang et al)".*

Traumatic Brain Injury

- *Cassidy JD, Cancelliere C, Carroll LJ, Côté P, Hincapié CA, Holm LW, et al.. Systematic review of self-reported prognosis in adults after mild traumatic brain injury: results of the international collaboration on mild traumatic brain injury prognosis. Arch Phys Med Rehabil. (2014) 95(3 Suppl.):S132–51. 10.1016/j.apmr.2013.08.299*

- *Marshall CM, Vernon H, Leddy JJ, Baldwin BA. The role of the cervical spine in post-concussion syndrome. Phys Sportsmed. (2015) 43:274–84. 10.1080/00913847.2015.1064301*

Traumatic Brain Injury

- *Iverson GL, Lange RT. Examination of "postconcussion-like" symptoms in a healthy sample. Appl Neuropsychol. (2003) 10:137–44. 10.1207/S15324826AN1003_02*

- *Wang Y, Chan RCK, Deng Y. Examination of postconcussion-like symptoms in healthy university students: relationships to subjective and objective neuropsychological function performance. Arch Clin Neuropsychol. (2006) 21:339–47. 10.1016/j.acn.2006.03.006*

- *Arciniegas DB, Anderson CA, Topkoff J, McAllister TW. Mild traumatic brain injury: a neuropsychiatric approach to diagnosis, evaluation, and treatment. Neuropsychiatr Dis Treat. (2005) 1:311–27.*

Traumatic Brain Injury
Chapter 4 – Nervous System:

Assessing Impairment via 4.1a – 4.1c

- Goal is to objectively assess change in / loss of functioning due to brain injury or 'concussion' in order to determine an accurate rating
- Consideration of evidence based medicine
- Chapter 14 adds, *"neuropsychological assessment . . . may be useful in determining deficiencies in brain functioning, particularly in individuals with subtle signs such as those that may be seen in traumatic brain injuries."*

Traumatic Brain Injury

Chapter 4 – Nervous System:

Neuropsychological Testing to objectively determine:

- **That the presenting symptoms are indeed due to a claimed TBI event**
- **That there may be alternate explanations for the presenting / claimed symptoms**
- **If a TBI is the correct diagnosis**
  - OBJECTIFY if there are residuals of TBI
  - Help to assess if at MMI
  - Help to determine IR.
    CANNOT JUST “eyeball” the IR

Traumatic Brain Injury
Chapter 4 – Nervous System:

Neuropsych Testing to objectively assess:

- MMPI – 2 – RF = Personality Testing / MMPI-3 / API = personality testing
- Specific tests with embedded validity criteria.
  - Victoria Symptom Validity Test (VSVT)
  - Dot Counting Test (DCT)
  - Portland Digit Recognition Test (PDRT)
  - Rey 15 Item Test
  - Test of Memory Malingering (TOMM)
  - Structured Inventory of Malingered Symptomatology
  - Word Memory Test (WMT)

Traumatic Brain Injury
Chapter 4 – Nervous System:

- Once testing is completed, as the ordering MD / DO, you must be familiar enough with how testing is conducted to determine if conclusions are accurate.
  - **Validity Criteria**
  - **Fake Bad**
  - **Fake Good**
- **Don't abdicate the decision of MMI or IR to the testing PhD / PsyD. They are not trained in the assessment of MMI or IR**

Traumatic Brain Injury
Chapter 4 – Nervous System:

- Be Aware that those with MILD TBI (even complicated mild) are **unlikely** to have:
  - Aphasia or communication issues
  - Permanent Disturbances of Consciousness
  - Major Motor or Sensory
  - Movement Disorder
  - Episodic Neurologic Disorders
  - Sleep and Arousal Disorders (Central Sleep Apnea)

Those conditions usually require significant injury to the basal ganglia, deep temporal lobes, a large part of a cerebral hemisphere, or other specific brain trauma.

Traumatic Brain Injury - General

4.1 Central Nervous System - Cerebrum or Forebrain

(AMA Guides, Page 140)

9 Categories of Impairment

- **Pick most severe of first five categories**
  1. Disturbances of consciousness and awareness
  2. Aphasia or communication disturbances
  3. Mental status and integrative functioning abnormalities
  4. Emotional/behavioral disturbances
  5. Special types of preoccupation or obsession

Traumatic Brain Injury
Chapter 4 – Nervous System:

- **If an impairment exists as a result of a mild TBI after 3 months, the two most common of the FIRST FIVE are:**
  1. Mental status and integrative functioning abnormalities
  2. Emotional/behavioral disturbances
- If one of the other conditions are claimed present, they are not probable to be seen in a Mild TBI.
- More probable due to some other diagnosis.

Traumatic Brain Injury - General

4.1 Central Nervous System
Cerebrum or Forebrain
(AMA Guides, page 140)

9 Categories of Impairment

- **Combine most severe of first five categories with ANY of last four categories**

6. Major motor or sensory abnormalities
7. Movement disorders
8. Episodic neurologic disorders
9. Sleep and arousal disorders

Traumatic Brain Injury
Chapter 4 – Nervous System:

- **If an impairment exists as a result of mild TBI after 3 months, it is highly improbable that ANY of the LAST FOUR would exist**
  6. Major motor or sensory abnormalities*
  7. Movement disorders*
  8. Episodic Neurologic Disorders
  9. Sleep and arousal disorders
- If there was not evidence for a Moderate or Severe TBI, these conditions would be more probable to be due to an ALTERNATE EXPLANATION
- **There are corresponding Tables in Chapter 4*

Chapter 4 – Nervous System:

Those with Mild TBI (even complicated Mild) are UNLIKELY to have:

- **Aphasia or Communication Disturbances (page 141)**
  - Receptive or Expressive Aphasia
  - Usually modulated by the left hemisphere in most individuals
  - Assessed via Table 1.
- **Permanent Disturbances of Consciousness (p 142)**
  - "stupor, coma, persistent vegetative state" (PVS)
  - Assessed via Table 4

Chapter 4 – Nervous System

Those with Mild TBI (even complicated Mild) are UNLIKELY to have:

- **Major motor or sensory abnormalities***
  - Thalamic sensory pain,
  - Gait or manual dexterity issues (weakness/spasticity)
- **Movement disorders***
  - Involuntary movements

    (tremors, chorea, hemiballismus, bradykinesia)
- **There are NO tables associated with these conditions and are discussed on page 140 and 141**
- Fortunately, is not very common but when present, defend IR assigned based on ADLs

Chapter 4 – Nervous System:

Those with Mild TBI (even complicated Mild) are UNLIKELY to have:

- **Episodic Neurologic Disorders – Epilepsy, Seizures and Convulsive Disorders.**
  - Immediate Seizures are within the first 24 hours
  - Early Seizures may occur in the 1st week after TBI
  - These occur while the brain is acutely traumatized, inflamed, and metabolically disrupted and usually with more significant TBIs.

Ding et al and McCrea

Chapter 4 – Nervous System:

Those with Mild TBI (even most complicated Mild) are UNLIKELY to have:

- **Early Seizures;** Risk factors for early seizures include:
  - "younger age (especially <5 years), acute intracerebral hematoma, acute subdural hematoma, diffuse cerebral edema, intracranial metal fragment retention, focal neurologic deficits, depressed/linear skull fractures, and loss of consciousness (LOC)/amnesia for >30 minutes"

Ding et al.

Chapter 4 – Nervous System:

Episodic Neurologic Disorders

- Late Seizures (> one week)
- Most commonly seen with:
  - *"age at injury >65, the presence of early post-traumatic seizures (in adults), subdural hematoma, brain contusion, premorbid chronic alcoholism, penetrating head injury, retained metal fragments in brain, depressed skull fracture, focal neurological deficits, degree of loss of brain tissue, and severity of injury."*

Chapter 4 – Nervous System:

Episodic Neurologic Disorders

Ding K, Gupta PK, Diaz-Arrastia R. Epilepsy after Traumatic Brain Injury. In: Laskowitz D, Grant G, editors. Translational Research in Traumatic Brain Injury. Boca Raton (FL): CRC Press/Taylor and Francis Group; 2016. Chapter 14. Available from: https://www.ncbi.nlm.nih.gov/books/NBK326716/

McCrea, MA (2008). Mild Traumatic Brain Injury and Post-concussion Syndrome: The New Evidence Base for Diagnosis and Treatment. American Academy of Clinical Neuropsychology. Oxford University Press.

Chapter 4 – Nervous System:

Those with Mild TBI (even complicated Mild) are UNLIKELY to have:

- **Sleep and Arousal Issues - Central Sleep Apnea (CSA)**
- CSA is due to a lack of central drive to breathe during sleep - the brain doesn't send proper signals to the muscles that control breathing.
  - There is decreased respiratory effort.
  - This results in repetitive periods of insufficient ventilation and compromised gas exchange.
- CSA is different from **obstructive sleep apnea** (OSA), in which cessation of breathing occurs because of upper airway obstruction with preservation of respiratory effort.
- Malhotra A, Owens RL. What is central sleep apnea? Respir Care. 2010 Sep;55(9):1168-78. PMID: 20799999; PMCID: PMC3417331.

Chapter 4 – Nervous System:

Those with Mild TBI (even complicated Mild) are UNLIKELY to have:

- **Sleep and Arousal Issues - CSA**
  - **Non-TBI causes:** heart failure, stroke, sleeping at high altitude, narcotic induced, obesity hypoventilation, uncontrolled OSA that caused cardiopulmonary complications and CSA
  - **TBI with brainstem involvement.**
- So even when CSA is present, there are multiple other considerations besides TBI

Chapter 4 – Nervous System:

Sleep and Arousal Issues - OSA is very common in the population

- Estimated prevalence in North America is approximately **15 to 30 percent in males and 10 to 15 percent in females (**apnea-hypopnea index greater than five events per hour of sleep)
- OSA increases with age and obesity.
  - In some elderly groups, was as high as 90% in men and 78% in women. #1
  - Among the risk factors, obesity is the most important. #2
  - Significant sleep apnea is present in ≈40% of obese individuals, **and ≈70%** of OSA patients are obese. #3

Chapter 4 – Nervous System:

Sleep and Arousal Issues - OSA is very common in the population

1 Chamara V. Senaratna, Jennifer L. Perret, Caroline J. Lodge, Adrian J. Lowe, Brittany E. Campbell, Melanie C. Matheson, Garun S. Hamilton, Shyamali C. Dharmage. Prevalence of obstructive sleep apnea in the general population: A systematic review. Sleep Medicine Reviews, Volume 34, 2017, P70-81 ISSN 1087-0792, https://doi.org/10.1016/j.smrv.2016.07.002.

2 Wolk R, Shamsuzzaman ASM, Somers VK. Obesity, Sleep Apnea and Hypertension. Hypertension. 2003, Volume 42, Issue 6: 1067-1074. https://doi.org/10.1161/01.HYP.0000101686.98973.A3

3 Vgontzas AN, Tan TL, Bixler EO, Martin LF, Shubert D, Kales A. Sleep Apnea and Sleep Disruption in Obese Patients. *Arch Intern Med.* 1994;154(15):1705–1711. https://doi:10.1001/archinte.1994.00420150073007

Chapter 4 – Nervous System:

SUMMARY: Sleep and Arousal Issues

Alternate Explanations to Sleep and Arousal Disorders are more common than CSA due to TBIs.

- Was the MOI and classification of TBI consistent with brainstem type TBI?
- Ensure that the CSA is not due to one of many other causes
- Ensure that the claimed sleep disturbance is CSA and not the very common OSA (although there can be overlap in uncontrolled OSA)

Chapter 4 – Nervous System:

SUMMARY TBI Rating:

- **MILD TBI likely to have no residual impairment, and IF there is, likely to be low grade:**
  - Mental Status Impairment (Table 2)
  - Emotional or Behavioral (Table 3)
- **MODERATE to (more likely) SEVERE TBIs, *MAY* be associated with:**
  - The other 3 of the most severe of FIRST FIVE
  - ANY of the LAST FOUR
  - ***Exceptions can exist, but explain the evidence***

Chapter 4 – Nervous System:

If there are other COMPLICATIONS of the TBI involving other organ systems, those can be combined with Chapter 4.1 impairments.

- Facial fractures and Cranial nerve lesions
- Mod / Severe TBI can be associated with
  - Visual Disturbance not due to cranial nerves (Ch 8)
  - Injury to auditory mechanism and tinnitus (Ch 9)
  - Pituitary dysfunction (Ch 12)
  - Spasticity & Heterotopic ossification (Ch 3 based on ROM limitations)
  - Tube Feedings – Stoma (Ch 10)

Traumatic Brain Injury

READY FOR SOME CASES?

Traumatic Brain Injury – Case 1

- 44-year-old female kitchen worker had a 10 lb. box of supplies fall on the left side of her head as she was reaching for it. It did not cause her to fall on the ground.
- She reported the event to her supervisor. She felt "dazed" for a minute or two but there were no other complaints. No LOC, anterograde, retrograde amnesia.
- She worked the rest of her shift and drove home.
- The next day (within 24 hours) she woke with a stiff neck and headache. She was concerned she had a concussion and drove herself to the local ER.

Traumatic Brain Injury – Case 1

- At the ER within 24 hours of the trauma, her complaints and ROS were positive for mild headache. There were no other potential concussion related symptoms.
- On exam her BMI was 40 and her BP was elevated.
- She smiled through the history. Her GCS was 15 and she was alert and oriented x 4. There were no external signs of trauma.
- Her neuro exam was benign. Her posterior spine and trapezius were diffusely tender.

Traumatic Brain Injury – Case 1

- X-ray of the C-spine demonstrated minor spondylosis. Additional F/E without instability.
- The claimant requested a CT scan of the head.
- The CT was without acute intracranial abnormalities. There was no extracranial swelling.
- She was diagnosed with *“head contusion”* & *"post-traumatic headache"* and released to work.

Traumatic Brain Injury – Case 1

- One week later she presented to an Urgent Care (UC). There was no intervening treatment.
- She reported severe headache, 9/10 with nausea/ vomiting (N/V), blurred / double vision, photophobia, phonophobia that had developed after the DOI.
- She reported that she had to be in a dark room and asked the TD to turn the lights off.
- Her vitals were the same BMI and again an elevated BP.
- Her exam was neurologically benign. There were increased verbal pain behaviors.

Traumatic Brain Injury – Case 1

- Her exam demonstrated severely restricted cervical ROM in all planes of motion with pain through out. All movements cased her headache to worsen.
- She was diagnosed with a *"Concussion"* and *"Cervical Strain".*
- The doctor informed her that *"it could take months to a year for the concussion to resolve".*
- She was also told that if her symptoms worsened they would get an MRI.

Traumatic Brain Injury – Case 1

- At follow up at 2 weeks, the claimant reported that her headaches were causing a ***"reoccurrence of her migraines".***
- Symptoms were the same with the **addition** of dizziness, and tinnitus / hearing loss in the left ear.
- Her exam demonstrated a new “positive” Romberg and her gait was "abnormal". She stated she could not hear anything on the left. Her CN exam was otherwise normal.
- She was diagnosed with *“post-concussion syndrome”.*
- The doctor referred her for 1. an MRI, 2. an ENT referral for evaluation of hearing loss and balance issues AND 3. an EEG for evaluations of seizures.

Traumatic Brain Injury – Case 1

- Several evaluations at the Urgent Care occurred over the next 3 months.
- She was started in PT for the neck sprain for 12 visits between weeks 3 and 6. All treatments completed by week 6,made her symptoms worse.
- An MRI of the brain was completed during week 6 post-injury. It was normal other than non-specific scattered foci of abnormal T2 / FLAIR signal in the periventricular white matter especially in the frontal lobes. These most likely represented areas of ***"microvascular ischemic change vs migrainous lesions".***

  https://pubmed.ncbi.nlm.nih.gov/2058506

- There were NO acute / sub-acute findings on MRI imaging.

Traumatic Brain Injury – Case 1

- An ENT doctor evaluated the claimant 3 months later. In addition to the severe dizziness and hearing loss, she reported depression, memory loss and sleep disturbance.
- She had an audiometry exam which demonstrated minor binaural high frequency hearing loss.
- The doctor diagnosed her with ***"concussion, hearing loss and post-traumatic dizziness".***
- He recommended: 1. Brainstem evoked potentials (BAEP), 2. EEG, 3. Balance training. The BAEP and EEG were not authorized.
- She completed 8 visits of balance training at the ENT's facility over 8 weeks (5 months post-injury) - no improvement.

Traumatic Brain Injury – Case 1

Designated Doctor Examination – 6 months

- The complaints and ROS were positive for severe headache, 9/10 with nausea/ vomiting (N/V), blurred / double vision, photophobia, phonophobia, hearing loss left ear / tinnitus, dizziness, weakness, memory loss, insomnia, daytime sleepiness.
- She complained of severe depression and inability to perform to perform ANY ADLs.
- She has had a high BMI most of her life.
- Her past medical history was positive for hypertension and migraines. She could not recall the name of her HTN medication. BOTH diagnoses were *"worse since the DOI".*

Traumatic Brain Injury – Case 1

Designated Doctor Examination – 6 months

- Has been treated for migraines in the past including preventative and abortive drugs. She could not recall the name or frequency of her these medication or frequency of past migraines
- The DD inquired specifically about psychological history.
  - She denied "depression" but admits being on fluoxetine for "stress"
  - She denied physical, sexual or emotional abuse as a child.

Traumatic Brain Injury – Case 1

Designated doctor Examination – 6 months

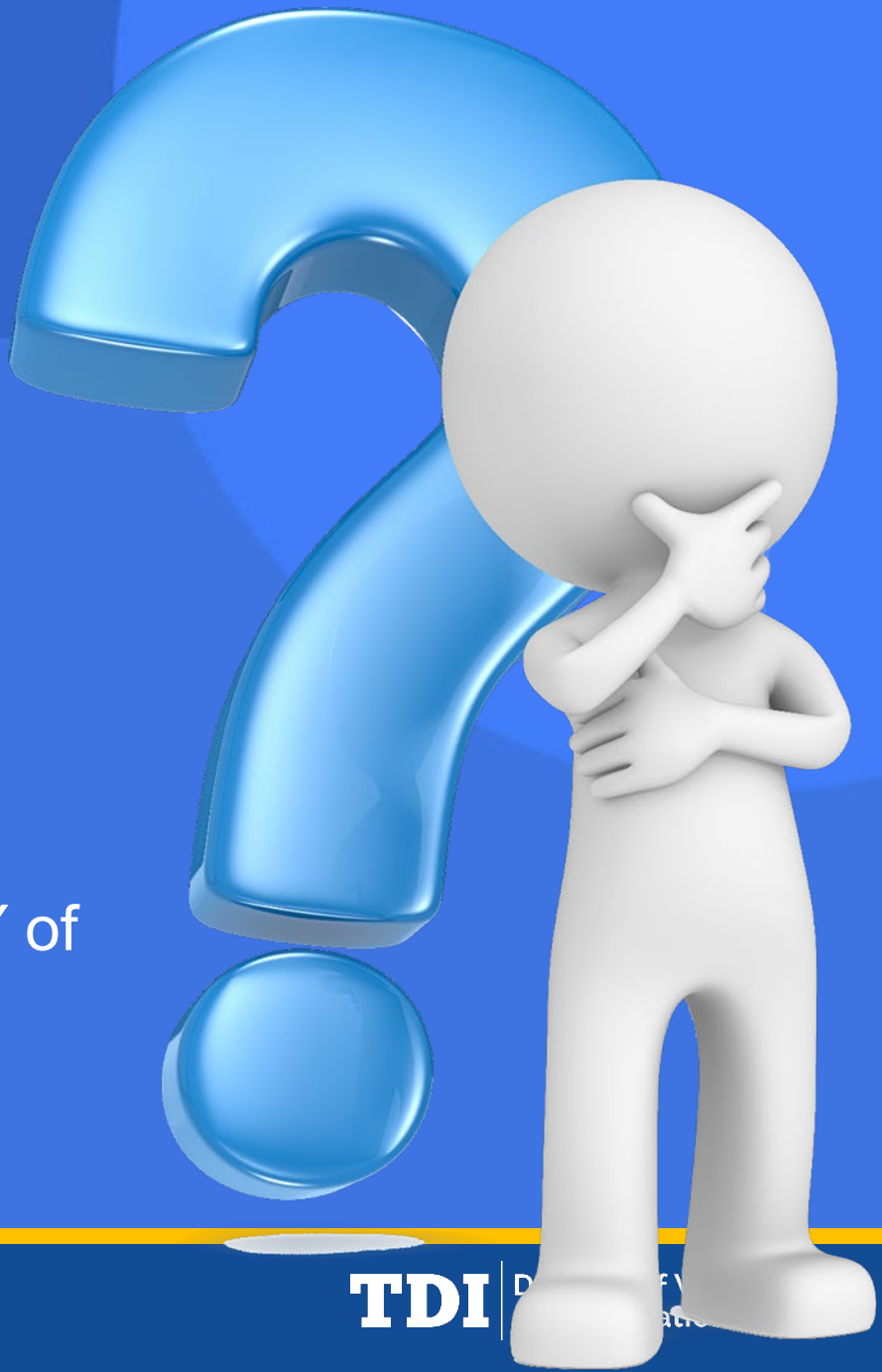
- Vitals were positive for elevated BMI (40) and BP.
- CN exam was normal other than perceived decreased hearing (CN VIII) on the left and decreased sensation on the left side of her face (CN V).
- On EOM testing, there was no end range nystagmus but complained of dizziness. Sensory exam was normal.
- There was give way weakness in all extremities.
- Romberg demonstrated dramatic balance sways without falls and she reported she could not Tandem Walk.
- Cervical ROM was severely restricted in all planes of motion and caused headache and dizziness.

Traumatic Brain Injury – Case 1

Designated Doctor Examination – 6 months

- The DD referred the claimant for Neuropsychological testing. Analysis of Test results:
  - There was no MMPI-2-RF conducted.
  - Claimant failed 2 of 4 validity tests and demonstrated infrequently endorsed items even for those with moderate to severe TBIs
  - The PhD diagnosed her with *"post-concussion syndrome and neurocognitive disorder."* He opined that MMI had not been reached and she needed cognitive rehabilitation.

Traumatic Brain Injury – Case 1



Question for DD:

What is the compensable injury?

The DD evaluates the TOTALITY of the evidence to determine the compensable diagnosis / MMI.

Traumatic Brain Injury – Case 1

Compensable Diagnosis(es)

A. Head contusion, post-traumatic headache, cervical strain

B. Head contusion, post-traumatic headache, cervical strain, concussion

C. Head contusion, post-traumatic headache, cervical strain, concussion, post-concussion syndrome, mild neurocognitive disorder

D. Head contusion, post-traumatic headache

Traumatic Brain Injury – Case 1

Most medically probable Compensable Diagnosis(es)

- Head contusion,
- Post-traumatic headache,
- + / - Cervical strain

WHY those diagnoses?

WHY NOT the other diagnoses?

Traumatic Brain Injury – Case 1

Most medically probable Compensable Diagnosis(es)

- WHY Head contusion, Post-traumatic headache?
- The MOI was a direct trauma, but consider the transmitted force

Why or why not cervical strain?

- Not much of a deforming force
- If you chose cervical strain, defend your answer

Traumatic Brain Injury – Case 1

Most medically probable Compensable Diagnosis(es)

WHY NOT concussion or traumatic brain injury?

- Other than "direct trauma", were any of the other criteria for concussion met?

WHY NOT post-concussion syndrome or mild neurocognitive disorder

- Ever expanding list of symptoms in a non-temporal relationship to the date of injury
- Neurocognitive disorder is not likely based on GCS and other TBI criteria and not validated by the insufficient Neuropsychological testing.

Traumatic Brain Injury – Case 1

Question for DD:

Has MMI been reached, and if so, what is the date of MMI?

Traumatic Brain Injury – Case 1

A. MMI – 3 weeks after the DOI
B. MMI – 6 weeks after the DOI
C. MMI – Date of ENT exam at 3 months
D. MMI – Date of the DD EXAM
E. Not at MMI – The claimant needs: EEG, Brainstem Evoked Potential, and Cognitive Rehabilitation

Traumatic Brain Injury – Case 1

Most Medically Probable Date of Maximum Medical Improvement:

- MMI – 6 weeks after the DOI

- WHY that date?
- WHY NOT the other dates?

Traumatic Brain Injury – Case 1

Question for DD:

On MMI date, what is whole person IR?

Traumatic Brain Injury – Case 1

IMPAIRMENT RATING for the Compensable Diagnoses based on the condition as of the date of MMI.

A. 0% WP each for head contusion, headaches, and cervical strain = 0% WP

B. 0% WP for head contusion, 0% WP for headache and 5% WP for the cervical strain or sprain = 5% WP

C. 0% WP for head contusion, 0% WP for headache and 5% WP for the cervical strain or sprain and 5% WP for emotional / behavioral disturbances = 10% WP

D. Cannot determine the IR as the claimant is not at MMI

Traumatic Brain Injury – Case 1

IMPAIRMENT RATING

- If compensable diagnoses determined by the DD were head contusion, headaches, and cervical strain
- MMI date was 6 weeks after the date of MMI.
- IR must be based on forensic analysis of the records, certifying exam for the condition on the date of MMI and considering the AMA Guides, 4th Edition AND based on the condition at MMI (130.1)
- 0% WP each for head contusion, headaches, and cervical strain = 0% WP

Traumatic Brain Injury – Case 1

IMPAIRMENT RATING

Why 0% impairment for head contusion / headaches?

- Guides have no specific rating. Headaches are rated as per the cause / source.
- The initial headache was likely secondary to the direct trauma OR cervicogenic and should have faded within days to weeks.
- Non-injury symptoms evolved over time.
- H/O migraines with likely mis-attribution of those headache symptoms to the work incident or a continuation of prior migraines.

Traumatic Brain Injury – Case 1

IMPAIRMENT RATING

Why 0% impairment for cervical strain?

- The MOI was low force and initial presentation on DOI was benign.
- Most low grade cervical strains should resolve or at least improve within days to weeks after the inciting incident.
- Increased non-injury factors over time.
- At MMI, uniformly restricted ROM without other DRE II differentiators

Traumatic Brain Injury – Case 1

WHY no IR for TBI?

- Worst of the First 5
- ANY of the last 4
- THESE ARE NOT CONSIDERED as the MOI, Timeline of subjective / objective, imaging and EBM were NOT consistent with a concussion form of TBI

Questions about Case 1?

Traumatic Brain Injury – Case 2

History of Injury

- Injured employee fell 15 feet, landing on his left side.
- GCS at the scene per EMS was 9 and at ER was 8.
- Emergent CT head was consistent with left zygomatic and lateral orbital wall fracture and small subdural hemorrhage in left frontotemporal region.
- CT cervical without acute injury
- Admitted to hospital and intubated / sedated due to combativeness. Early seizure before seizure prophylaxis started.

Traumatic Brain Injury – Case 2

History of Injury

- An CT of the brain performed the day after DOI was consistent with
  - Left temporal contusion,
  - Relatively stable left subdural hematoma
  - Contre-coup contusion right temporoparietal area
  - No diffuse swelling and the ventricular areas were normal
  - The prior fractures were also noted with increased soft tissue swelling

Traumatic Brain Injury – Case 2

- The IE spent 10 days in the acute care hospital before he was admitted to the rehabilitation hospital.
- At the time of his rehab admit, he was still somewhat combative / inappropriate and had a low GOAT score.
- Remained in a CARF accredited inpatient rehab for 3 weeks and CARF outpatient for 6 months, completed at ~ 9 months after the DOI.

- **Levin HS, O'Donnell VM, Grossman RG. The Galveston Orientation and Amnesia Test. A practical scale to assess cognition after head injury. J Nerv Ment Dis. 1979 Nov;167(11):675-84. doi: 10.1097/00005053-197911000-00004. PMID: 501342.**

Traumatic Brain Injury – Case 2

History of Injury

- In therapy at ~ 3 months, the claimant had a witnessed Grand Mal seizure and subsequently suffered intermittent minor focal motor seizures in the right upper extremity
- EEG confirmed abnormal seizure activity in the left temporal lobe
- Responded to anti-seizure medication with no recurrence of Grand Mal seizures after 6 months, but continued mild focal motor seizures.
- Saw the neurologist monthly between months 3 - 9

Traumatic Brain Injury – Case 2

DD Evaluation > 18 months after DOI - History

- He saw his PM&R doctor monthly for the first year after the DOI.
- The IE returned to work with some changes in duties at 9 months.
  - He keeps a notebook and uses his phone as a memory aid.
  - He functions at work, as the things he does are based on prior / old memory.
- At 12 months he reported to the PM&R doctor that he has more difficulties in new situations or social situations, and that can make him anxious.

Traumatic Brain Injury – Case 2

DD Evaluation - > 18 months after DOI - History

- At 12 months, the PM&R doctor was of the opinion that he was stable enough in function to be seen every 6 months
- He still had problematic breakthrough seizures, so continued to see the neurologist monthly up to 9 months after the DOI and then every 3 months up until 18 months after the DOI. At 18 months, the IE was to follow up every 6 months for a med check
- His employer made him supervisor of the crew at ~ 14 months.
- The IE felt he was making improvements in memory and function until ~ 18 months after the DOI.

Traumatic Brain Injury – Case 2

DD Evaluation > 18 months after DOI - EXAM

- Alert and oriented x 4
- Mood / affect within normal limits, but appears anxious.
- Increased psychomotor activity, but no exaggerated pain behaviors.
- Speech is without dysarthria.
- Mild difficulty finding words, naming objects, minimal difficulty following multi-step commands if offered slowly.
- No other obvious receptive or expressive aphasia

Traumatic Brain Injury – Case 2

DD Evaluation > 18 months after DOI - EXAM

- Cranial nerve function intact
- Gait and Cerebellar Exam remarkably normal
- No sensory / motor deficits
- No spasticity, hyperreflexia, clonus, and negative Hoffman's / Babinski test
- No evidence of a movement disorder

Traumatic Brain Injury – Case 2

DD Evaluation - > 18 months after DOI

DD orders MRI of brain and internal auditory canals with contrast

- Left temporal lobe encephalomalacia
- No residual left subdural hematoma, resolved contusion of right temporoparietal area
- No obvious trauma to the internal auditory canal (IAC)

Traumatic Brain Injury – Case 2

DD Evaluation

- **DD considered the medical evidence in the records, the certifying exam and the EBM.**
- **Ordered Neuropsychological evaluation to evaluate residuals of the TBI**
  - Results were a valid representation with good effort, consistent responses
  - Results consistent with residual mild cognitive deficit. Also consistent with
    - location of original or residual imaging abnormalities
    - Other evidence in the records

Traumatic Brain Injury – Case 2

Question for DD:

What is the compensable injury?

Traumatic Brain Injury – Case 2

Traumatic Brain Injury, moderate to severe

While this case had other MSK injuries, *for the sake of focusing on the TBI, we will consider MMI and the IR for only the TBI portion of this case.*

Traumatic Brain Injury – Case 2

Question for DD:

Has MMI been reached, and if so, what is the MMI date?

Traumatic Brain Injury – Case 2

DATE OF MMI:

A. Nine months after the DOI

B. 12 months after the DOI

C. 18 months after the DOI

D. Not at MMI

Traumatic Brain Injury – Case 2

Question for DD:

On MMI date, what is the whole person IR?

Case 2 - Traumatic Brain Injury

4.1 Central Nervous System - Cerebrum or Forebrain

(AMA Guides, Page 140)

9 Categories of Impairment

- **Pick most severe of first five categories**
  1. Disturbances of consciousness and awareness
  2. Aphasia or communication disturbances
  3. **Mental status and integrative functioning abnormalities**
  4. Emotional/behavioral disturbances
  5. Special types of preoccupation or obsession

Traumatic Brain Injury - Case 2

Case 2 - Traumatic Brain Injury

4.1 Central Nervous System
Cerebrum or Forebrain
(AMA Guides, page 140)

9 Categories of Impairment

- **Combine most severe of first five categories with any of last four categories**

6. Major motor or sensory abnormalities
7. Movement disorders
8. **Episodic neurologic disorders**
9. Sleep and arousal disorders

Traumatic Brain Injury - Case 2

Traumatic Brain Injury – Case2

- 1% - 14% (Table 2)
- cw 0% -14% (Table 5) =
- **1% WP - 26% WP**
  - Select the single IR percentage within range that best fits clinical condition of IE

Explain how and why

Traumatic Brain Injury – Case 2

- Remember the ADL table on page 317.
- That Table may not have enough detail related to the functions in the tables in Chapter 4.
- Review the relevant tables in Chapter 4 related to the residual deficits, so that you can ASK the appropriate questions!

Questions about Case 2?

Traumatic Brain Injury – Case 3

- 32-year-old female warehouse worker was walking among wide aisles of product on pallets.
- She came around a corner and was startled by a forklift coming in her direction.
- She stepped back and stumbled, such that she went back into the row that she came from, fell onto her right buttock and grazed the right side of her head on a pallet behind her.
- She reported the event to her supervisor. She felt "dazed" for a minute but there were no other complaints. No LOC, anterograde / retrograde amnesia.
- She worked the rest of her shift and drove home.

Traumatic Brain Injury – Case 3

- The next day (within 24 hours) she woke with a stiff neck and headache. She was concerned she had a concussion and drove herself to the local ER.
- At the ER within 24 hours of the trauma, her complaints and ROS were positive for mild headache.
- There were no other potential concussion related symptoms (nausea, vomiting, photophobia, blurred vision, dizziness, tinnitus, alterations in cognition, etc.)
- She appeared anxious through the history.
- She complained of right buttock and right posterior head / neck pain.

Traumatic Brain Injury – Case 3

- Her presenting GCS was 15/15 and her vitals were stable other than an elevated HR of 100.
- She was A and O x 4, but anxious.
- There were no external signs of trauma on her posterior right head or right buttocks.
- Her posterior cervical spine and trapezius were diffusely tender without midline tenderness.
- Full cervical and right hip ROM
- Her neuro exam was benign. She was capable of tandem walk, Rhomberg was negative, EOM conjugate without nystagmus and no photophobia demonstrated on checking pupils.

Traumatic Brain Injury – Case 3

- X-ray of the C-spine demonstrated minor spondylosis.
- A CT of the head and neck were not performed based on NEXXUS / **Canadian CT Head Injury/Trauma Rule**
- She was diagnosed with *“head contusion”* & *"post-traumatic headache"* and released to work full duty for the following day.

Traumatic Brain Injury – Case 3

- After no intervening treatment, she presented to an Urgent Care a week later, after missing work for several days and her supervisor telling her she needed a note for the missed work.
- She reported severe headache, 9/10 with nausea/ vomiting (N/V), blurred / double vision, photophobia, phonophobia that had developed in the days AFTER the DOI.
- She reported that she "*feared for her life"* and that "*she was inches away from being run over and killed by the forklift".*
- Her vitals continued to demonstrate an elevated HR.
- She had an anxious demeanor.

Traumatic Brain Injury – Case 3

- There were increased verbal pain behaviors.
- Her exam was neurologically benign, although there were some non-physiologic "findings".
- Her exam demonstrated severely restricted cervical ROM in all planes of motion with pain through out. All movements cased her headache to worsen.
- She was diagnosed with a *"Concussion"* and *"Cervical Strain".*
- The doctor informed her that *"it could take months to a year for the concussion to resolve".*
- She was started in PT

Traumatic Brain Injury – Case 3

- At follow up at 2 weeks, the claimant reported that her headaches were causing repetitive eye twitching and triple vision (triplopia = non-physiologic)
- Symptoms were the same with the **addition** of dizziness, and tinnitus / hearing loss in the right ear.
- On that date, her exam demonstrated a new “positive” Romberg and her gait was "abnormal".
- She stated she could not hear anything on the right.
- On EOM testing, she had complaints of double / triple vision.
- CN exam was otherwise normal.
- An added diagnosis was *“post-concussion syndrome”.*

Traumatic Brain Injury – Case 3

- Several evaluations at the Urgent Care with the TD occurred between week 2 and 16.
- She was started in PT for the neck sprain for 9 visits between weeks 2 and 4. All treatments made her symptoms worse.
- At completion of therapy, the PT documented:
  - "Normal" sensory / reflex exams and give-way weakness.
  - No improvement in uniformly restricted ROM. All movements made head and neck pain worse.

Traumatic Brain Injury – Case 3

- TD saw at 5 weeks. Due to persistent complaints an MRI of the brain was ordered
- MRI completed during week 6 post-injury and was normal with NO acute / sub-acute findings on MRI imaging.
- At follow-up after the imaging at 7 weeks, the TD reassured the claimant.
- She then reported nightmares, palpitations, reliving the incident at work, insomnia, abnormal behavior, cognitive / memory difficulties and "losing time".
- The doctor ordered more PT which was denied.

Traumatic Brain Injury – Case 3

- At 3 months after the DOI, the claimant returned to the TD / UC and was wearing sunglasses throughout the evaluation.
- She complained of worse visual symptoms, including loss of visual acuity, and increasing dizziness with multiple falls.
- She demonstrated minimal cervical movement, was using a cane for balance and could not perform a Rhomberg test.
- She began demonstrated irregular and unusual, whole truncal jerking motions.
- An additional 6 PT visits were approved and the focus was on vestibular therapy and her neck.

Traumatic Brain Injury – Case 3

- The IE completed additional 6 visits of vestibular PT by 16 weeks without improvement
- Similar symptoms continued and at 16 weeks, the Urgent Care MD became *"concerned about PTSD".*
- She was referred to a LCSW who administered a Beck Depression Inventory, a Beck Anxiety index and a PCL-5.
- As a result of the screening exams, the LCSW diagnosed the claimant with major depression, generalized anxiety and PTSD.
- Cognitive behavioral therapy and Sertraline were recommended.
- At follow up at 18 weeks, the treating MD adopted those diagnoses AND continued the concussion and post-concussion syndrome diagnoses.

Traumatic Brain Injury – Case 3

- The claimant changed treating doctors, because *"her prior treating doctor was not understanding her issues".*
- The new doctor made a referral to his Chronic Pain Management Program .
- 80 hours were approved and completed by 9 months after the incident, with "improvement" in VAS from 10/10 to 8/10, and *"less depressed".* NO change in functional abilities, cognitive abilities or other psychological symptoms were documented.
- The new doctor recommended continued CPMP, which was approved and completed just less than 12 months after the DOI.
- At the completion of the total 160 hour of the CPMP, similar results to the initial 80 hours were reported.

Traumatic Brain Injury – Case 3

Designated Doctor Examination – @ 12 months

- The DD obtained a similar but more dramatic MOI to the initial MOI reported.
- It was reported that she flew back 10 feet after tripping backwards, violently striking the pallets behind her head with a "LOC for at least 30 minutes".
- She reported that she could not talk or think the rest of her work shift and was dizzy and vomited at work.
- She did not go to the ER because she thought it would get better but her symptoms got worse over the next week.

Traumatic Brain Injury – Case 3

Designated Doctor Examination – @ 12 months

She reported the following symptoms to the DD:

- Headaches and neck pain
- Severe anxiety, insomnia, nausea / vomiting, dizziness, photophobia, phonophobia / right sided hearing loss
- Loss of visual acuity, double and triple vision PLUS abnormal right eye twitching and abnormal sensation around the right eye
- Numbness, tingling and weakness of the limbs that would come and go, and body twitching
- Memory loss, loss of time, increased startle, nightmares

Traumatic Brain Injury – Case 3

Designated Doctor Examination – @ 12 months

- The DD inquired specifically about psychological history.
  - Physical, emotional and sexual abuse as a child by family / relatives.
  - No formal psychological treatment, but history of substance abuse with "successful rehab".
  - Has been treated with amitriptyline, gabapentin for Pain, Seroquel for sleep, Cymbalta for pain and pain and depression at varying doses and overlapping with each other at points prior to the DOI.

Traumatic Brain Injury – Case 3

Designated Doctor Examination – @ 12 months

- Elevated heart rate, increased psychomotor activity and elevated pain behaviors.
- Spoke with a halting, stuttering speech pattern
- Wore sunglasses and used a cane.
- Would not do Rhomberg, Tandem Gait or otherwise let go of her cane.
- Removed her sunglasses for EOM testing. She appeared to cross her eyes at unusual points during testing.
- Although there were dramatic sighs, there was no end range lateral gaze nystagmus or dizziness reported during testing.

Traumatic Brain Injury – Case 3

Designated Doctor Examination – @ 12 months

- Hearing was intact to tuning fork bilaterally, despite complaints of complete hearing loss on the right
- She reported vague decreased sensation around her right eye.
- The remainder of CN testing was normal.
- Cerebellar testing demonstrated unusual, non-physiologic findings.

Traumatic Brain Injury – Case 3

Designated Doctor Examination – @ 12 months

- Cervical ROM was virtually nil, and all ROMS performed reproduced "dizziness"
- On casual observation, she moved her neck far greater than on formal ROM
- When not formally tested, while sunglasses off, the claimant tracked the examiner in the room with normal conjugate gaze and no eye blinking

Traumatic Brain Injury – Case 3

Designated Doctor Examination – @ 12 months

- Demonstrated unusual and irregular truncal body movements / jerks and tremors
- Vague and patchy sensory abnormalities in arms, legs and truck
- Give- way weakness all extremities
- No hyperreflexia, spasticity, clonus and no asymmetry of reflexes
- ** The unusual truncal body movements / jerks and tremors abated while doing sensory / motor / reflex testing*

Traumatic Brain Injury – Case 3

DD referred for neuropsychologic testing – completed at 13 months after DOI

Clinical interview:

- It was reported that she had dyslexia and she believed she has attention problems but was not formally diagnosed with ADHD.
- Prior to the work injury diagnosed with “anxiety and depression”.
- She reported making a suicide attempt at age 19, trying to hang herself via a towel suspended in a door.
- She reported that she vomited most mornings for several years,
- Her mother had Bipolar Disorder, and both biological parents were substance dependent for many years.

Traumatic Brain Injury – Case 3

Designated Doctor Examination – @ 12 months

Neuropsychologic testing results

Meyers Index was at a level consistent with symptom exaggeration.

MMPI-2-RF:

- *"Self-report validity scales associated with overreporting of symptoms were elevated to a degree that is consistent with exaggeration of symptoms, and the degree of exaggeration was sufficient to invalidate the psychological portion of the assessment".*
- This was most prominent in relation to somatic, neurological, and cognitive complaints
- Reports of unusual symptoms rarely endorsed by others.

Traumatic Brain Injury – Case 3

CONCLUSIONS of Neuropsychologic Testing

- Physical movement abnormalities were "functional" or "psychogenic" rather than consistent with a physical / medical condition.
- *"Her presentation would be considered one of the Somatic Symptom Disorders"* and provided EBM to support the opinion.
- He opined that the DSM-5 diagnosis most consistent with her observed and reported symptoms is Conversion Disorder / Functional Neurological Symptom Disorder.

Traumatic Brain Injury – Case 3

Question for DD:

What is the compensable injury?

Traumatic Brain Injury – Case 3

Compensable Injury

A. Head contusion, buttock contusion, cervical strain
B. Head contusion, buttock contusion, cervical strain, concussion / mTBI
C. Head contusion, buttock contusion, cervical strain, concussion / mTBI, post-concussion syndrome
D. Head contusion, buttock contusion, cervical strain, concussion / mTBI, post-concussion syndrome PLUS PTSD, major depression and generalized anxiety disorder

Traumatic Brain Injury – Case 3

Compensable Injury

Best answer

A. Head contusion, buttock contusion, cervical strain

The diagnoses above are consistent with the minor MOI and initial presenting symptoms. These would be of a mild degree based on lack of initial significant findings.

Traumatic Brain Injury – Case 3

Question for DD:

On MMI date, what is the date of MMI?

Traumatic Brain Injury – Case 3

A. MMI – 4 weeks after the DOI – Completed 9 PT visits without improvement
B. MMI – 7 weeks after DOI – when TD reviewed the normal MRI
C. MMI – 16 weeks after the DOI – completion of vestibular therapy
D. MMI – 13 months after DOI - Date of the Neuropsych exam
E. 5. Not at MMI – She needs treatment for her psychologic symptoms including PTSD

Traumatic Brain Injury – Case 3

BEST ANSWER:

- For diagnosis of head contusion and cervical strain, MMI was reached at 4 weeks after the DOI.
- Completed 9 PT visits for the cervical strain without improvement
- No concussion, so vestibular therapy, MRI, and any other psychologic treatment was not related to the compensable injury

Traumatic Brain Injury – Case 3

Question for DD:

On MMI date, what is whole person IR?

Traumatic Brain Injury – Case 3

IMPAIRMENT RATING for the Compensable Diagnoses based on the condition as of the date of MMI.

A. 0% WP each for head contusion, buttock contusion, and cervical strain = 0% WP

B. 0% WP for head contusion / buttock contusion and 5% WP for the cervical strain or sprain = 5% WP

C. 0% WP for head contusion, and 5% WP for the cervical strain or sprain and 15% WP for emotional / behavioral disturbances = 19% WP

D. Cannot determine the IR as the claimant is not at MMI

Traumatic Brain Injury – Case 3

IMPAIRMENT RATING

- If compensable diagnoses determined by the DD were head contusion, buttock contusion and cervical strain, these were low grade injuries and should have resolved
- Best answer is A = MMI date was 4 weeks after the date of MMI after trial of ODG recommended PT. No response / worsening.
- IR must be based on forensic analysis of the records, certifying exam for the condition on the date of MMI and considering the AMA Guides, 4th Edition.
- 0% WP each for head contusion, buttock contusion (resolved by one week) and cervical strain = 0% WP

Traumatic Brain Injury – Case 3

IMPAIRMENT RATING

- Criteria for concussion were not met. Not every direct trauma results in a concussion.
- Even IF there had been a concussion, only initial symptom burden was potentially a headache, so the lowest grade of a mTBI - recall the EBM related to resolution.
- The other symptoms added over time and not temporally related to the events of the DOI.
- Symptoms / "Findings" (number and spectrum) were inconsistent with the severity of injury
- Non-physiologic findings

Traumatic Brain Injury – Case 3

IMPAIRMENT RATING

- PTSD, major depression and generalized anxiety disorder were diagnosed by screening subjective tests without internal validity measures, and NOT supported by the Neuropsychologic testing
- Neuropsychologist diagnosed a specific type of Somatoform Disorder. These are not caused by a work event and more probable that the work event allows them a vehicle to express their internal psychologic turmoil

Traumatic Brain Injury – Case 3

Questions?

Thank you