

Western Occupational and Environmental Medical Association  
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## Mild Traumatic Brain Injury

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(PDT)**

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Faculty Disclosure:  
Lorne Direnfeld, MD, FRCP has no conflict of interest to disclose.

## Mild Traumatic Brain Injury

Lorne Direnfeld MD

## Outline

- Scope of the problem.
- Definition.
- Grading severity.
- Mechanism of injury (pathology).
- Symptoms.
- Treatment.
- Prognosis.
- Persistent Post-Concussion Syndrome (PPCS).
- Areas of controversy.

## Mild TBI Case Study

(with a sad result)

## The Symptoms

- Mr. A is a 30-year-old Construction Worker who complains of "shaky vision", pain at the back of the head, problems with balance, and "surges", among other symptoms.
- Symptoms are attributed to the effects of an injury on the job three years ago.

## The Injury

- At the time of the injury, Mr. A was on some scaffolding. He was putting backing between rafter tails. He stood up and hit one of them with his forehead. He was knocked down to his knees.
- He reported being dazed. The injury occurred at about 10:00 a.m. He continued to work. He completed his workday until 3:00 p.m.

## Clinical Course

- On the evening of the injury day, he had a bad headache.
- The day after the injury Mr. A was evaluated by his primary care physician. Symptoms included headache and numbness in the face and both arms. He was diagnosed with cervical spine degenerative disc disease and acute neurologic symptoms. Additional investigations were planned.

## Let's Do Some Tests

- X-rays of the cervical spine showed mild degenerative changes.
- An MRI scan of the brain was normal.

## Things Are Not Going Well

- Three weeks later Mr. A was evaluated in an emergency room for complaints of severe headache and left face numbness, as well as fluttering visual disturbance. He was noted to have had a recent closed head injury and to have undergone an MRI scan with normal findings. He was examined and diagnosed with acute headache. Neurologic evaluation was recommended.

## The Beginning of the End

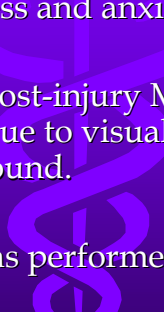
- One month post-injury Mr. A was evaluated by Neurologist 1. Symptoms included headache, problems with memory, dizziness, irritability, and fatigue. Mr. A was examined. Findings included tenderness to palpation at the back of the head. Mr. A was otherwise intact neurologically.
- He was diagnosed with headache, numbness, memory loss, and vertigo, as well as . . . **traumatic brain injury (!!!)**.

## Sewing the Seeds of Destruction

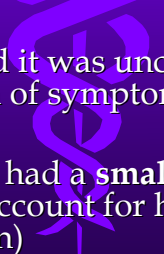
- Elavil and Lyrica were prescribed. Treatment with an occipital nerve block was recommended.
- Mr. A was told it may take 6 to 12 months for his condition to improve

## More Tests and Opinions

- Ten weeks post-injury an MRI scan of the cervical spine was obtained and showed mild degenerative changes.
- A second neurologist Dx "moderate" head injury, without significant brain injury and cervical strain.

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- Fourteen weeks post-injury Mr. A was evaluated by Neurologist 3 who Dx closed head injury without loss of consciousness and anxiety.
  - Seventeen weeks post-injury Mr. A saw a neuro-ophthalmologist due to visual symptoms. No abnormality was found.
  - ENT evaluation was performed. Findings were negative.

### Physiatrist 1

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- Eighteen weeks post-injury Mr. A was evaluated by Physiatrist 1. He was described as having a host of unusual symptoms including involuntary movements of both upper and lower extremities, impaired vision, pain and stiffness of the neck, and just not being himself since the injury.
  - The physiatrist said it was unclear what the complete spectrum of symptoms could be from.
  - It was noted Mr. A had a **small traumatic brain injury** that could account for his symptoms. (More seeds of destruction)

## Physiatrist 2

- Twenty four weeks post-injury Mr. A was evaluated by Physiatrist 2. Mr. A complained of headache, neck pain, poor memory, difficulty concentrating, emotional lability, dizziness, and nausea.
- He was diagnosed with post-concussive syndrome.
- **Treatment** at a community-oriented program specializing in **traumatic brain injury** was recommended. (The plot thickens.)

## Neuropsychological Evaluation

- Nine months post-injury Mr. A underwent neuropsychological evaluation.
- He was diagnosed as having a **somatization disorder**.
- Mr. A's symptoms were thought to be of psychogenic origin.



## Neurologist 4

- One year post-injury Mr. A was evaluated by Neurologist 4, a seizure specialist. Mr. A reported recurrent, at times frequent, episodes of abnormal movements of the arms or legs.
- Mr. A was examined.
- No abnormalities were found.

- Thirteen months post-injury Mr. A was admitted to a hospital for three days of intensive video EEG monitoring.
- During the admission, Mr. A reported experiencing various events.
- No EEG abnormalities were found.
- Neurologist 4 concluded that the events were psychogenic.
- There was no evidence on the EEG or on any of the testing that there was any indication of brain injury.

**Mr. A was unconvinced that he was not brain injured!  
(It is hard to un-ring the bell.)**

- Mr. A expressed a desire to go to a brain injury rehab program on the mainland.

**A 4 \_ Month Admission!**

- Fifteen months post-injury Mr. A was admitted to a brain injury program on the mainland, where he stayed for four and a half months!

## Iatrogenesis Magnus

- Psychiatrist 3 evaluated Mr. A at the brain injury rehabilitation program and diagnosed mild traumatic brain injury, headaches of multifactorial origin, post-traumatic visual disturbance, and possible vestibular dysfunction, among other conditions.
- Treatment with physical therapy, occupational therapy, speech therapy, cognitive therapy, and neurobehavioral therapy was instituted.

## Another MRI of the Brain

- Eighteen months post-injury a second MRI scan of the brain was performed on Mr. A.
- The study was performed using sequences including diffusion tensor imaging.
- Findings were normal.

## Time to Come Home

- Following his discharge after 4\_ months in the mainland rehabilitation facility, Mr. A returned to his home in Hawaii and continued follow-up with a new primary care physician, as well as another neuropsychologist.

## More Pills

- When Mr. A returned to Hawaii, medications included:
- Ritalin 20 mg twice a day to treat decreased attention and concentration,
- meclizine 25 mg twice a day to treat vestibular dysfunction,
- propranolol 10 mg two tablets three times a day for autonomic instability,

### Yet Even More . . .

- Mirapex 0.5 mg at bedtime to treat periodic limb movements impairing sleep,
- baclofen 10 mg at bedtime to treat neck spasm,
- Lamictal 150 mg twice a day for seizures,
- Namenda 5 mg twice a day for cognitive decline attributed to traumatic brain injury,

### And More . . .

- Vicodin one to two tablets as needed every four hours for pain,
- Prilosec 40 mg a day for gastroesophageal symptoms,
- Ativan 2 mg three times a day as needed for anxiety, and
- ibuprofen 600 mg three times a day as needed for pain.

### Return to Neurologist 3

- Two and a half years post-injury Mr. A was reevaluated by Neurologist 3
- Diagnoses included:
- Non-epileptic/psychogenic seizures.
- History of closed head injury with multiple persisting subsequent somatic complaints including visual disturbance and imbalance, not of objectively supported primary organic origin.
- Somatoform disorder versus conversion disorder (with seizures).

### Don't Forget "The Injury"

- Mr. A was on some scaffolding. He was putting backing between rafter tails. He stood up and hit one of them with his forehead. He was knocked down to his knees. He reported being dazed. The injury occurred at about 10:00 a.m. He continued to work. He completed his workday until 3:00 p.m.

### Note!!!

- Mr. A was **not rendered unconscious and had no post-traumatic amnesia.**
- There were never any objective abnormalities on multiple clinical examinations by various specialists.
- There were never any abnormalities on any objective tests.

### Surprise!!

- Among the conclusions noted in Mr. A's case was that the condition was, to a great extent, of iatrogenic origin.

## A Sad Result

- Mr. A remains off work and believes he is permanently brain injured.

- 1.5 million people with a TBI each year in the US.
- 90% of these cases are mild injuries.
- Almost half were seen only in the clinic, physician office, or not at all.



## Definition of Traumatic Brain Injury

- A traumatically-induced structural injury and/or physiological disruption of brain function as a result of an external force that is indicated by new onset or worsening of at least one of the following clinical signs immediately following the event:
- Any period of Loss of, or decreased Level of, Consciousness (LOC).
- Any loss of memory for events immediately before or after the injury (Post-Traumatic Amnesia/PTA).
- Any alteration in mental state at the time of the injury (confusion, disorientation, slowed thinking, etc.) (Alteration of Consciousness/mental state/AOC).
- Neurologic deficits (weakness, loss of balance, change in vision, praxis, paresis/plegia, sensory loss, aphasia, etc.) that may or may not be transient.
- Intracranial lesion.

## Severity of Brain Injury

- TBI can be categorized as mild, moderate, or severe based on various criteria.
- Acute injury severity is determined at the time of the injury.

CRITERIA	Mild	Moderate	Severe
Structural Imaging	Normal	Normal or abnormal	Normal or abnormal
Loss of Consciousness (LOC)	0 – 30 minutes	Greater than 30 minutes and less than 24 hours	Greater than 24 hours
Alteration of Consciousness/Mental State (AOC)	A moment up to 24 hours	Greater than 24 hours severity based on other criteria	Greater than 24 hours severity based on other criteria
Post Traumatic Amnesia (PTA)	0 – 1 day	Greater than 1 and less than 7 days	Greater than 7 days
Glasgow Coma Scale Score (best available score in first 24 hours)	13 – 15	9 – 12	Less than 9

### Mechanism of Injury

- Mild traumatic brain injury is Diffuse Axonal Injury (DAI). The mechanism is believed to be lateral shearing damage to axon processes and small blood vessels.
- In mild TBI, the axons are not transected, but locally damaged, affecting intracellular transport and membrane stability.
- Failure of function in the distal axon can lead to secondary transsynaptic injury.

## Concussion

- The terms **concussion** and **mild TBI** can be used **interchangeably**.
- The use of the term **concussion** or **history of mild TBI** may be preferred when communicating with the patient. This indicates a transient condition and avoids the use terms such as "brain damage" or "brain injury."
- These terms may inadvertently reinforce misperceptions of symptoms or insecurities about recovery.

## Please Note This Point!!!

- The patient who is told that he or she has "brain damage" based on vague symptoms, complaints, and no clear indication of significant head trauma may develop a long-term perception of disability that is difficult to undo.

## Symptoms Associated with Concussion/Mild TBI

- Symptoms may manifest immediately following the event and resolve quickly within minutes to hours, or may persist longer.
- Typical signs and symptoms fall into three main categories.
- Somatic/physical
- Cognitive/intellectual
- Affective/behavioral/emotional complaints.

### Somatic

- Physical/somatic complaints include headache, nausea, vomiting, dizziness, fatigue, blurred vision, sleep disturbance, sensitivity to light/noise, balance problems, and other transient neurologic abnormalities.

### Cognitive

- Cognitive/intellectual problems include difficulty with attention, concentration, memory, speed of processing, judgment, and executive function.

### Affective

- Affective/behavioral/emotional complaints include depression, anxiety, agitation, irritability, impulsivity, and aggression.

## Conceptual Point

- Although a variety of symptoms can occur in association with TBI, they are not part of the definition of mild TBI.
- There are no pathognomonic signs or symptoms.

- The term mild TBI only refers to the initial injury severity, and should not be interpreted as referring to the level of severity of subsequent symptoms.
- Signs and symptoms following mild TBI should not be attributed to mild TBI if they are better explained by pre-existing conditions or other medical, neurological, or psychological causes, except in cases of immediate exacerbation of a pre-existing condition.
- Symptoms associated with mild TBI are not unique and occur frequently in day-to-day life among healthy people, and are often found in persons with other conditions such as chronic pain, depression, or other traumatic injuries.

## Diagnosing Mild TBI

- The diagnosis of mild TBI is based primarily on the patient's history.
- The history should include detailed information of the injury event including the mechanism of injury and the duration and severity of altered consciousness, as well as immediate symptoms and symptom course.

## Injury Description

- Was there evidence of a forcible blow to the head?
- Was it direct or indirect?
- Is there evidence of intracranial injury or skull fracture?
- What was the location of the impact (frontal, occipital, right, left, etc.)?
- What was the cause? Was it a motor vehicle accident, a fall, a sports injury, an assault, a blast, or something else?
- Were there any deaths or injuries to others that occurred as a result of this event?

- Assess for post-traumatic amnesia.  
Are there events immediately preceding or following the injury for which the person has no memory, even briefly?
- Does the patient report loss of consciousness?
- Was there an early appearance of being dazed, stunned, confused, or forgetful?

### **Clinical Course**

- Define the patient's symptoms, clinical course and resolution, or lack thereof, since the time of injury.
- Documenting frequency and severity of symptoms is important to set a baseline for monitoring subsequent treatment efficacy or establishing co-occurring conditions.

## History of Past Health and Personal/Social History

- The history should also include screening for premorbid conditions, potential co-occurring conditions, and psychosocial risk factors such as substance use disorders that may exacerbate or maintain certain symptom presentation.

## Physical Examination

- Physical examination of a person with mild TBI should include a detailed neurologic exam and musculoskeletal examination including examination of the head, neck, and jaw.



## Imaging

- The role of neuroimaging in diagnosing mild TBI continues to evolve.
- Structural imaging modalities include CT scanning and MRI scanning.
- Currently CT scanning is the modality of choice in the acute concussion setting. The absence of abnormal findings on a CT scan does not preclude the presence of concussion/mild TBI.

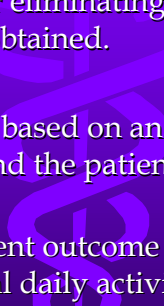
## Treatment Approach

- Build a therapeutic alliance with patients.
- Interactions with patients and their families involving real or suspected MTBI may be highly emotional. Reactions may range from disbelief to anger to frustration to relief.
- Information provided to individuals who have mild TBI can either amplify and increase their symptoms and distress (iatrogenic factors) or can minimize and normalize their symptoms and reduce stress.
- The lack of a definitive diagnosis or single effective treatment can make the management of patients with mild TBI challenging, and cause frustration of both the patient and provider.
- To counter this, a high level of patient trust and faith in the clinician is required to maintain continuity of care.
- A therapeutic alliance between the patient and clinician should be established during the initial evaluation.


## How Can The Partnership With A Patient Be Strengthened?

- Acknowledge and indicate commitment to understanding the patient's concerns and symptoms.
- Encourage open and honest transfer of information that will provide a more comprehensive picture of the patient's concerns and medical history.
- Present information regarding a positive outcome and symptom remission to create an expectation of recovery.
- Indicate commitment to allocate sufficient time and resources to resolving the patient's concerns.
- Avoid open skepticism or disapproving comments in discussing the patient's concerns.

- Treatment of patients with mild TBI focuses on symptom management and the education of the patient and family.
- Education should emphasize recovery, gradual resumption of work, and social responsibilities, and teaching compensatory strategies and environmental modifications.
- Patients should be encouraged to implement changes in lifestyle including exercise, diet, sleep hygiene, stress reduction, relaxation training, scheduling leisure activities, and pacing to improve treatment outcomes.
- Although activity restrictions are a part of the treatment regimen in the acute post-injury period, activity reduction does not imply complete bed rest. It implies a restful pattern of activity throughout the day with minimal physical and mental exertion.

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- Part of the early intervention for mild TBI involves protecting the patient from a secondary insult or further injury by limiting or eliminating job requirements until proper recovery is obtained.
  - Return to activity is based on an inventory of symptoms and their severity and the patient's job-specific tasks.
  - A successful treatment outcome is the return to work or school or other usual daily activities

## Symptom Management

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- There is a complex relationship among mild TBI symptoms (sleep, headache, cognition, and mood, for example). It is reasonable to expect that alleviating or improving one symptom may lead to improvement in others

## Headache

- Headaches may have different qualities, but overall best fit either muscle tension, headache accompanying cervical strain, or vascular headaches with or without a pre-existing history of migraine.
- There are no specific interventions for most post-traumatic headaches.
- Post-traumatic vascular headaches have the same characteristics as common migraine. Nausea is a common accompaniment. Sensory sensitivities are variable, but common.
- In the first days after injury, it is reasonable to treat headaches with analgesics including over-the-counter medications or opiates. However, these should not be continued as a primary treatment for headaches.
- If headaches persist, more specific treatment should be utilized.
- The symptomatic and preventive medications for vascular headache in the post-traumatic context are identical to the standard migraine options.

## Dizziness

- For complaints of unsteadiness, treatment with anti-vertigo medications is not usually effective.
- For patients with true vertigo and who have findings consistent with benign positional vertigo (BPPV), treatment with the Epley maneuver is recommended.
- For patients whose complaint of dizziness is most consistent with pre-syncope, patient education regarding postural changes can be helpful.

## Sleep Disorders

- Sleep disorders are common in patients with mild TBI.
- Depression, anxiety, and rumination may affect sleep, as may pain.
- Improvements in headache, fatigue, concentration, attention, and mood may all hinge on improvements in sleep.
- Counseling regarding sleep hygiene and brief use of sleep-inducing medication may be helpful.

## Cognitive Complaints

- In the majority of patients with mild TBI, cognitive complaints clear spontaneously.
- The differential diagnosis of cognitive complaints includes anxiety disorders, chronic pain, depression or other mood disorders, insomnia, substance abuse, and other medical conditions.

- Comorbid psychiatric problems, including major depression and anxiety disorders, as well as substance abuse disorders, should be treated aggressively using appropriate psychotherapeutic and pharmacologic interventions.
- Non-pharmacologic treatment includes encouraging regularly scheduled aerobic exercise, appropriate activity restriction or adjustment, and sleep hygiene education (as noted above).
- In selected patients, cognitive rehabilitation may be indicated.

## Therapeutic Exercise

- Therapeutic exercise has been shown to positively impact many disabilities.
- These exercises can be general and directed at an overall improvement in cardiopulmonary health, physical strength and power, and overall wellbeing.
- Alternatively, exercises may focus on significant musculoskeletal, sensory, or neuromuscular impairments that limit performance of daily activities.

## Prognosis

- The majority of people with mild TBI will have no difficulties or complaints within days to weeks or a few months following injury.
- A minority of patients will have ongoing symptoms that may result in disability.

## Persistent Post-Concussive Syndrome (PPCS)

- The point at which MTBI becomes PPCS has been somewhat arbitrarily considered by some researchers to be by approximately three to four months post-injury.
- Symptoms of PPCS are similar to those of MTBI.

RISK FACTORS FOR PPGS or POORER OVERALL OUTCOME

<u>Pre-Injury</u>	<u>Peri-Injury</u>	<u>Post-Injury</u>
<ul style="list-style-type: none"> <li>•Age (older).</li> <li>•Gender (female).</li> <li>•Low socioeconomic status.</li> <li>•Less education – lower levels of intelligence.</li> </ul>	<ul style="list-style-type: none"> <li>•Lack of support system.</li> <li>•Acute symptom presentation (for example, headache, dizziness, or nausea in the emergency room).</li> </ul>	<ul style="list-style-type: none"> <li>•Compensation.</li> <li>•Litigation (malingering, delayed resolution).</li> <li>•Co-occurrence of psychiatric disorders.</li> </ul>

<u>Pre-Injury</u>	<u>Peri-Injury</u>	<u>Post-Injury</u>
<ul style="list-style-type: none"> <li>•Pre-neurologic conditions.</li> <li>•Pre- or co-occurrence of mental health disorders (depression, anxiety, traumatic stress, or substance abuse).</li> </ul>	<ul style="list-style-type: none"> <li>•Context of injury (stress).</li> </ul>	<ul style="list-style-type: none"> <li>•Co-occurrence of chronic pain conditions.</li> <li>•Lack of support system.</li> <li>•Low education.</li> </ul>




## Memory

- No one's memory is perfect. Worrying about and focusing on each lapse will make your memory seem worse.

### THINGS WE NORMALLY FORGET

Symptom	% People
• Forgets telephone numbers	58%
• Forgets people's names	48%
• Forgets where the car was parked	32%
• Loses car keys	31%
• Forgets groceries	28%
• Forgets why they entered a room	27%
• Forgets directions	24%
• Forgets appointment dates	20%
• Forgets store location in shopping center	20%
• Loses items around the house	17%
• Loses wallet or pocketbook	17%
• Forgets contents of daily conversations	17%

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- The symptoms of PPCS are very much like normal signs of daily stress.
  - Patients forget how common stress-related symptoms are in everyday life.

### SYMPTOMS OF EVERYDAY STRESS

Symptom	% of People
• Poor concentration	14%
• Irritability	16%
• Tired a lot more	13%
• Depression	20%
• Memory problems	20%
• Headaches	13%
• Anxiety	24%
• Trouble thinking	6%
• Dizziness	7%

## Treatment

- Early detailed education about the anticipated symptoms of MTBI, including the highly favorable prognosis, is a useful, but often neglected, intervention.
- Unexpectedly prolonged symptoms are commonly iatrogenic due to:
  - Repeated testing and imaging ("there must be something wrong or they wouldn't keep testing").
  - Referral to a different specialist for every symptom; neurology, physiatry, orthopedics, ENT, psychiatry, physical therapy, neuropsychology, chiropractic, massage therapy, craniosacral therapy, etc., etc., etc.

- Substituting tests purported to be diagnostic for brain injury (for example, quantitative EEG) for informed clinical assessment. There is nothing like an abnormal test, no matter how bogus, to convince someone that there "must be something wrong."
- Failure to address early emerging psychological factors.
- Legal obstacles to return to health and logistical obstacles to return to work.

## Consultation?

- Consultation or specialty referral should occur in patients with MTBI who complain of persistent or chronic symptoms when:
  - There is an atypical pattern or course (worsening or variable symptom presentation).
  - The patient is experiencing difficulties in return to preinjury activity (work/school).
  - Problems emerge in the role of the patient in family or social life.
  - Patients with multiple problems may benefit from an interdisciplinary rehabilitative approach including physical or occupational therapy and supportive psychotherapy.
- The primary care provider should remain involved in the patient's care.

## The Military

- A very significant effort has been made to establish criteria for the diagnosis of either mild TBI or Post-Traumatic Stress Disorder (PTSD), or both, in soldiers returning from combat.
- They cannot be cleanly distinguished by symptoms alone.
- In the US' experience, PTSD is common and associated with an increase in somatic and other PPCS symptoms.

## Clinical Practice Guidelines

- TBI is the leading cause of death and disability, especially among young adults. This is also true for the military population, both during times of peace and war.
- In an effort to provide the highest level of care to TBI victims, the military adopts "standard of care" practices, even in the deployed setting.
- This has been found to make a remarkable improvement in patient outcomes.

- For conditions in which civilian Clinical Practice Guidelines (CPGs) exist, they are used. When CPGs do not exist in civilian practice, they are developed.
- The military process by which CPGs are adapted or created is similar to that in civilian practice. A group of subject matter experts is convened, some of whom are civilian.
- A critical review of the medical literature is performed.
- An evidenced-based CPG is created. It then undergoes peer review.
- The CPG is then published to enable wide dissemination.

- For mild TBI, a civilian CPG did not exist. Therefore, in 2008 a joint VA-DoD working group was convened to develop one.
- The result is the "Management of Concussion/Mild Traumatic Brain Injury" CPG.
- This was released in 2009. It is available free to military and civilian health care professionals. It is an evidence-based CPG for managing subacute and chronic symptoms.
- This can be downloaded at:  
[http://www.healthquality.va.gov/mtbi/concussion\\_mtbi\\_full\\_1\\_0.pdf](http://www.healthquality.va.gov/mtbi/concussion_mtbi_full_1_0.pdf)

### **American Academy of Neurology**

- Practice Parameter: The Management of Concussion in Sports
- [http://www.aan.com/professionals/practice/guidelines/pda/Concussion\\_sports.pdf](http://www.aan.com/professionals/practice/guidelines/pda/Concussion_sports.pdf)

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