An Update on Brain Injury: PART 1: Terms, Trends, and Demographics

**TIME ORDERED AGENDA:**

**Part I:**
- 8:30-8:45 Introductions/Overview
- 8:45-9:15 New Terms & Definitions
- 9:15-10:00 Update on statistics, demographics, & risk factors

10:00 – 10:15 BREAK

- ASHA Update
- Experiential Communication: Treatment EBP Update
- Treatment Stages & Principles & Dilemmas

**Part II: Brain Injury Treatment & Executive Functioning 1:30–5:00**

- School Re-entry
- Treatment Executive Functioning: Interventions Across the Lifespan

12:00 – 1:30 LUNCH

**LEARNING OUTCOMES:**

At the end of this presentation, the participants will be able to:

- Define terms that are often confused or misused, as well as newly coined terms
- Identify risk factors for sustaining a brain injury, and identify high-risk groups
- Explain the outcomes of concussions and the best practices surrounding concussion
WHO AM I?

- Background
- Education
- Work
- Education
- Research
  - Survivors- RTS & RTW
  - TBI & School Services- SLPs & IEPs
  - Telehealth- students & PD

WHO ARE YOU?

- Student/clinician
  - Student at what level?
  - How seasoned of a clinician?
- Work place?
- Had a client/student with TBI?
  - How many?
- What are some things you’d like to know/clarify today?
- Any terms confusing to you?

BEFORE WE GET STARTED...

...humor can function as a motivational and communicative strategy to reduce cognitive dissonance in and for message senders during instances of psychological discomfort. Humor allows for the pairing of disjointed ideas, and according to humor theorists, people laugh when they experience “ill-suited pairings of ideas”, situations, or concepts…”

(Keith-Spiegel, 1984, p. 19)
CURRENT TERMS AND TRENDS

IN THE FIELD OF BRAIN INJURY

TBI DEFINED

- A TBI is caused by a _________, _________, or _________ to the head or a penetrating head injury that disrupts the normal function of the brain.
- Not all blows or jolts to the head result in a TBI.
- The severity of a TBI may range from “mild,” i.e., a brief change in mental status or consciousness to “severe,” i.e., an extended period of unconsciousness or amnesia after the injury.
- Not all persons who experience a TBI will have behavioral effects or a TBI-related disability.

HTTP://WWW.CDC.GOV/TRAUMATICBRAININJURY/BASICS.HTML
CORRIGAN, SELASSIE, AND ORMAN, 2010

DEFINITION CONTINUED...

- Explosive blasts can also cause TBI, particularly among those who serve in the U.S. military.
- Observing one of the following clinical signs constitutes an alteration in brain function:
  - Any period of loss of or decreased _______________
  - Any loss of memory for events immediately _______ or _______
  - Neurologic deficits such as muscle weakness, disruption of vision, change in speech and language, etc.
  - Any alteration in mental state such as confusion, disorientation, slowed thinking, etc.
PRIMARY MECHANISMS OF INJURY

- Occur at the time of trauma
- Related to the instantaneous effects of acceleration/deceleration (________) and rotational forces acting on the skull and brain

TRANSLATIONAL ACCELERATION

- Occurs when a vector of force is applied through an object’s center of gravity
- Results in linear acceleration of the object
CAVITATION EFFECTS

- With sufficient acceleration with respect to diameter of head, ______ will drop below vapor pressure level of intracellular fluid
  - Causes change from liquid to gaseous state—gas bubbles form within cells
  - Within milliseconds, pressure returns to above vapor pressure level and gas bubbles ______ and return to liquid state
  - Causes multiple small explosions that destroy brain cells

ROTATIONAL ACCELERATION

- Occurs when vector of force does not pass through an object’s center of gravity
- Causes a rotation of the object around its center of gravity

ROTATIONAL ACCELERATION

- Results in shearing strain throughout the brain
  - Multiple forces cause the simultaneous pulling of single or adjacent particles in more than one direction
SECONDARY MECHANISMS OF INJURY

- Injuries not from the primary mechanisms but not occurring at the time of injury
- Chain reaction of events that follow the primary injuries
  - Hematomas
  - Increased Intracranial Pressure
  - Cerebral Swelling
  - Cerebral Edema

A TBI BY ANY OTHER NAME...

- "Head" injury vs. Brain injury
- Closed head injury
- Open head injury
- Acquired brain injury (ABI)
- Concussion
- Brain contusion
- CTE

ACQUIRED BRAIN INJURY (ABI)

- Blows to the head
- Gunshot wounds
- Brain tumors
- Birth traumas
- Shaken baby syndrome
- Hypoxia
- Cardiac arrest
- Severing of carotid artery
- Anoxia
  - Near-drowning
  - Suffocation
  - Exposure to toxins
  - Cerebrovascular accidents
  - Brain hemorrhages
  - Exposure to explosions
PART 1 BUZZ TERMS

- Concussion
- CTE
- Second Impact Syndrome

We will talk about these more in a minute...

STATISTICS & DEMOGRAPHICS UPDATE:

Who are the typical brain injury survivors?

STATISTICS

- Each year, traumatic brain injuries contribute to a substantial number of deaths and cases of permanent disability.
- In 2010, 2.5 million TBIs occurred either as an isolated injury or along with other injuries.

NATIONAL HOSPITAL DISCHARGE SURVEY (NHDS), 2010; NATIONAL HOSPITAL AMBULATORY MEDICAL CARE SURVEY (NHAMCS), 2010; NATIONAL Vital Statistics System (NVSS), 2010. ALL DATA SOURCES ARE MAINTAINED BY THE CDC NATIONAL CENTER FOR HEALTH STATISTICS.
Statistics

- 3rd most common cause of death in U.S.; most common cause of death in people under the age of 38 (in 2010, more than 50,000 people died)
- A contributing factor to 30% of all injury-related deaths in the U.S.
- More frequent in U.S. than in European countries—WHY?
- From 2001-2010, TBI ED visits increased by 70%, hospitalization only increased by 11%—why?
- Death rates decreased by 7%
- 80,000 - 90,000 Americans experience long-term disability following a TBI each year
- 3.17 million people are disabled secondary to TBI

Frequency of TBI: At Risk Age Groups

- Highest risk groups
  - _______ year olds
  - _______ year olds
  - _______ year olds

- Lowest risk groups
  - 5-14 year olds

Risk Factors

Gender
- Men were more than 2 times as likely to die as women (2001-2010)
- Men had higher rates of TBI hospitalizations and ED visits than women.

Age
- Rates were highest for persons 65 years and older.
- Hospitalization rates were highest among persons aged 65 years and older.
- Rates of ED visits were highest for children aged 0-4 years.

http://www.cdc.gov/traumaticbraininjury/get_the_facts.html
Leading Causes of TBI, ED Visits

- 0-4: Falls
- 5-14: Falls & then Struck by/against
- 15 to 24 years: Falls, MVAs, & Struck by/against
- 5-14: Falls & then Struck by/against (really close)
- 65 years or older: Falls (82%)
- 5-14 years: Falls, Assaults, & MVAs
- 65 years or older: Falls (82%)
- 25-44 years: Falls, Assaults, & MVAs
- 45-64 years: Falls (MVAs are a distant second)

http://www.cdc.gov/traumaticbraininjury/get_the_facts.html

Leading Causes of TBI, Hospitalization

- 65 years or older: Falls (7 times more than any other cause)
- 0-4: Falls
- 5-14: Falls then MVAs
- 65 years or older: Falls
- 15 to 24 years: MVAs
- 45-64 years: Falls and then MVAs
- 25-44 years: MVAs
- 5-14: Falls then MVAs

http://www.cdc.gov/traumaticbraininjury/get_the_facts.html

Leading Causes of TBI-related Deaths

- 65 years or older: Falls
- 15 to 24 years: MVAs then Assaults
- 45-64 years: MVAs and then Falls
- 25-44 years: MVAs and then Assaults
- 5-14: Assaults then MVAs
- 4-14: Assaults then MVAs

http://www.cdc.gov/traumaticbraininjury/get_the_facts.html
A Major Problem Compounding the problem!

- Hospitalization
- Only 16.8% of people in the US who sustain TBIs each year are hospitalized
  - Approximately 235,000 people per year
- About 2/3 are discharged within two days
- Severe injuries may require hospitalization for months
- Unreported/unrecognized injuries
- Most people who sustain mild TBIs are not hospitalized and may not even be seen by a medical professional at the time of injury
- Over 25% of all TBIs are mild

Criteria used to classify TBI severity

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Mild</th>
<th>Moderate</th>
<th>Severe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Structural imaging</td>
<td>Normal</td>
<td>Normal or abnormal</td>
<td>Normal or abnormal</td>
</tr>
<tr>
<td>(LOC) Loss of consciousness</td>
<td>less than 30 min.</td>
<td>30 min - 24 hours</td>
<td>More than 24 hours</td>
</tr>
<tr>
<td>(PTA) Post traumatic amnesia</td>
<td>0-1 day</td>
<td>More than one day, less than 7</td>
<td>More than 7 days</td>
</tr>
<tr>
<td>GCS score (best available in 24 hours)</td>
<td>13-15</td>
<td>9-12</td>
<td>3-8</td>
</tr>
<tr>
<td>Abbreviated Injury Scale score: Head</td>
<td>1-2</td>
<td>3</td>
<td>4-6</td>
</tr>
</tbody>
</table>

Social Characteristics (pre-existing)

- Persons who sustain TBIs do not represent random sampling of normal population
- Over-representation of individuals with:
  - Low socioeconomic status
  - Learning disabilities
  - “At risk” behaviors

Pre-existing Health Problems

- Prior head injury
- Alcohol abuse
- Heart disease
- Psychiatric illness
- Seizure disorder

Incarceration & Substance Abuse

- Estimated prevalence of TBI in imprisoned populations is 60.1% (Shiroma, Ferguson, and Pickelimer, 2012).
- Statewide sample in SC: TBI in approximately:
  - 65% of men
  - 72% of women (Ferguson, et al., 2012)
- 12% - 63% of clients in substance abuse programs report a history of brain injury
- How and when these populations experienced a TBI & the circumstances are unclear.

Health effects associated with TBI

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cognitive</td>
<td>Deficits in: attention; learning and memory; executive functions like planning and decision-making; language and communication; reaction time; reasoning and judgment</td>
</tr>
<tr>
<td>Behavioral/Emotional</td>
<td>Delusions; hallucinations; severe mood disturbance; sustained irrational behavior; agitation; aggression; confusion; impulsivity; social inappropriateness</td>
</tr>
<tr>
<td>Motor</td>
<td>Change in muscle tone; paralysis; impaired coordination; change in balance, or trouble walking</td>
</tr>
<tr>
<td>Sensory</td>
<td>Change in vision and hearing; sensitivity to light</td>
</tr>
<tr>
<td>Somatic signs &amp; Symptoms</td>
<td>Headache, fatigue, deep disturbance, dizziess, chronic pain</td>
</tr>
</tbody>
</table>
Questions

Concussions
• Overview
• Management
• Resources

TIME ORDERED AGENDA

10:15-10:45 Concussion Overview
10:45-11:30 Concussion Management
11:30-12:00 Concussion Resources

12:00 – 1:30 LUNCH

AFTERNOON (1:30-5:00):
Brain Injury Treatment & Executive Functioning
Mild TBI & Concussions Overview

- Definition
- Complicating Factors
- Sports Stats and Facts

Mild TBI Definition (mTBI)

Traumatically induced physiological disruption of brain function, as manifested by at least one of the following:

1. any period of loss of consciousness
2. any loss of memory for events immediately before or after the accident
3. any alteration in mental state at the time of the accident (e.g., feeling dazed, disoriented, or confused)
4. focal neurological deficit(s) that may or may not be transient

...But where the severity of the injury does not exceed the following:

- loss of consciousness of approximately 30 minutes
- after 30 minutes, an initial Glasgow Coma Scale (GCS) of 13–15
- posttraumatic amnesia (PTA) not greater than 24 hours

This definition includes: 1. the head being struck, 2. the head striking an object, and 3. the brain undergoing an acceleration/deceleration movement (i.e., whiplash) without direct external trauma to the head. Also, a penetrating cranioencebral injury (OHI) is either moderate or severe.
Complicating Factors of “mild” brain injury
4 main issues:
- Problems identifying
- Variation of length and severity of persistent symptoms
- Physiological Changes
- Overlap with other disorders

Problems Identifying Mild TBIs
- Mildness of the injury causes:
  - Survivors to neglect seeking medical attention
  - Medical personnel not to inform survivors fully about their medical status and the possibility of long-term consequences
  - Damage will not show on CT scans or MRI scans
  - Skull fracture occurs in 10% of cases of mild TBI

Symptoms
- Person appears to have made a full recovery, but then has debilitating symptoms: Post-concussion Syndrome (controversial term).
- However, up to as many as 1/3 of survivors may have symptoms that last for 3 or more months and that prevent SUCCESSFUL return to work or school.
Physiological Changes Occurring with Concussion

- Rapid elevation of blood pressure
- Irregular respiration or apnea
- Decreased EEG activity
- Increased ICP for short time
- Temporary impairment of blood-brain barrier
- Diffusely scattered swelling of axons in cerebral white matter

Overlap with other Disorders

- Depression
- Anxiety Disorders
- Post-traumatic Stress Disorder (PTSD)

High Risk Sports

- Boxing
- Football
- Ice Hockey
- Martial arts
- Rugby
- Wrestling
- Soccer
- Auto racing
- Equestrian sports
- Motorcycle riding
- Sports diving
- Bicycling
- Snow skiing
- Basketball
- Baseball
- Softball
- Field hockey
- Volleyball
Percent of Athletes Sustaining Injuries

- **Boys**
  - Football - 6.0%
  - Wrestling - 4.4%
  - Soccer - 3.4%
  - Basketball - 1.3%
  - Baseball - 1.2%

- **Girls**
  - Soccer - 6.0%
  - Softball 2.4%
  - Basketball - 2.3%
  - Field Hockey 2.1%
  - Volleyball - 0.4%

Numbers are underestimates because many concussions are _______ ________

Sports-related Concussions in the U.S.

Concussion rates doubled in a decade
- There are an estimated 1.6 to 3.8 million sports-related concussions in the United States every year.
- High school athletes sustain an estimated 136,000 to 300,000 concussions per year.
- A 2012 study of 20 high school sports: 2/3 of concussions (66.6%) occurred during *competition* and one-third (33.4%) during *practice*.
- Athletes ages 16-19 yrs. sustain 29% of all sports-related concussions….while this is not surprising, it should scare you...

Concussion in Professional Football Players

- **Occurrence**
  - 60% of retired professional football players had sustained at least one concussion over the course of their career
  - 24% had sustained 3 or more concussions

- **Symptoms and consequences**
  - 54% had loss of consciousness
  - 52% experienced memory loss
  - 18% reported long term cognitive deficits
Problem of Education and Denial

- People do not acknowledge the significance of concussion
- Coaches and athletes view concussion as:
  - Just a “ding”
  - Getting your “bell rung”
  - A rite of passage
  - A Purple Heart that an athlete has to learn to endure

Management of Concussion

- Graduated Return-to-play example:
- Graduated RTS example:
- Youth Concussion Management (REAP)

Factors that might delay recovery:

- a history of a previous concussion or other brain injury,
- neurological or mental health disorders,
- learning difficulties, and/or
- family and social stressors.

Seek immediate medical attention if any of these symptoms are present:

- Headaches that Worsen
- Neck Pain
- Unusual Behavior Change
- Weakness/Numbness in Arms/Legs
- Looks Very Drowsy (Cannot be Awakened)
- Repeated Vomiting
- Change in State of Consciousness
- Can’t Recognize People or Places
- Increased Confusion or Irritability
- Slurred Speech
- Seizures
- For children under 2 years, any scalp swelling or abnormality in the way they usually behave.
- And if possible, see a medical professional who has knowledge of and experience (certification) with brain injury.
Management of Concussion

- Identify potential neurosurgical emergencies
  - Prevent catastrophic outcome related to acute brain swelling
- Avoid cumulative brain injury related to repeated concussions
- The younger the person, the more conservative the management should be because of potential for Second Impact Syndrome

Second Impact Syndrome

- Particularly dangerous in young athletes
- Rare
- Results in fatal brain edema
- Following a second concussion
  - Having symptoms from a prior concussion
  - Dangerous and potentially fatal
    - 50% die
    - Survivors sustain massive brain damage
- Can be prevented by recognition of concussion symptoms, ONLY

Second Impact Syndrome

- Caused by:
  - Reactive swelling of axons
  - Temporary anatomical changes that occur with concussion
  - Metabolic changes
    - Cerebral blood flow decreases at same time that brain has increased need for energy (sugar)
    - May last from 2 to 10 days post-injury – not really known how long metabolic changes persist

Preston Plevritis: Second Impact Syndrome
https://www.youtube.com/watch?v=F4foY1EtmKo
Important Factors in Determining Response to Injury

- Time since previous concussion
- Number of previous concussions
- Severity of concussion
- Pre-injury factors – genetic status, general state of vulnerability of brain (drinking alcohol, certain medications)

State Child Safety Laws

- Car/Booster Seat/Belt Law (ages 1-19)
- Carbon Monoxide Alarms (Home)
- Carbon Monoxide Alarms (School)
- Smoke Alarm (All Homes)
- Bike Helmet
- Sports Concussion
- Life Jackets
- Graduated Driver's License
- Ignition Interlock
- Drinking
- Texting
- Motorcycle Helmets
- Schools Require AEDs
- Speed Limits
- Yes (under 8)
- Yes (all ages)
- Yes
- No
- No
- Yes (under 13)
- 15 years
- Yes
- Yes
- No
- Yes (off road)
- 15 years
- Yes
- Yes
- No

Computerized Neuropsychological Tests

- Automated Neuropsychological Assessment Metrics (ANAM)
- CogSport
- Concussion Resolution Index
- Immediate Postconcussion Assessment and Cognitive Testing (ImPACT)
1) There is no such thing as a minor concussion!!!!

Brain injury is totally different from injury to all other parts of the body.

Never trust an athlete to make a return-to-play decision!!!
Concussion Resources

Brain 101: http://brain101.orcasinc.com/

CDC- Heads Up: http://www.cdc.gov/heads up/index.html

CTE - Chronic traumatic encephalopathy

- Neurodegenerative disease confirmed postmortem
- Highest risk: professional (contact sport) athletes and military personnel
- All neuropathologically confirmed CTE cases, to date, have had a history of repetitive head impacts.
- Not all repetitive brain trauma results in CTE.

Questions...so far?