Workplace Traumatic Brain Injury: Prevention and Rehabilitation

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ATLANTA
Save the Brain Helena!
TBI Basic Review
Concussion
Concussion
Traumatic brain injury is now a federal priority!

• “The physical, emotional, economic, and social toll of brain injury is not only exacted on survivors and their families, but also reaches friends, caregivers, and the community.”

Hon. Leona Agulkaq, Minister of Health: May 31, 2013

• Traumatic brain injury is the most misunderstood, misdiagnosed and underfunded public health problem our nation faces.”

Susan H. Connors, President & CEO Brain Injury Assoc. of America
What is a concussion?

- “A type of traumatic brain injury (TBI) caused by a bump, blow, or jolt to the head, or by a hit to the body that causes the head and brain to move rapidly back and forth.”
  
  [CDC headsup.org](https://www.cdc.gov/headsup/)

- The brain bounces around or twists in the skull, stretching and damaging brain cells. Chemicals are then secreted, which cause concussion symptoms.
Concussion Statistics

- A major public health problem!!
- An estimated 1.7 million people sustain a TBI. Of those:
  - 52,000 die
  - 275,000 are hospitalized
  - 1.365 million, nearly 80% are treated and released in the emergency room
- TBI’s account for approximately 30% of all injury related deaths in the U.S.
- Direct medical costs and indirect costs of TBI, loss of productivity, totaled an estimated $60 billion in the U.S. in 2000.
- Highest incidence in children/youth and older adults
- Less than 10% of all TBI’s cause loss of consciousness.
TBI by external cause

- Falls are the leading cause of TBI.
- Falls result in the greatest number of TBI related emergency department visits (523,043) and hospitalizations.
- MVA’s are the leading cause of TBI related deaths.

CDC.org
Incidence of TBI vs. other illness/injury in the United States

The University of Montana Rural Institute
Incidence of Traumatic Brain Injuries in Montana

- The rate of TBI deaths in Montana is the 2nd highest in the nation!!
- The rate of TBI hospitalizations and emergency department visits: 585 per 100,000 persons per year
- National average: 632 per 100,000 persons per year.
Signs/Symptoms

- Majority of systems resolve in 7-10 days

- **Concussions DON’T PLAY FAIR and they are NEVER the same!!**

- Concussion symptoms overlap with other disorders…depression, anxiety, ADD, learning disabilities, motion sickness, migraine headaches, bipolar, and even stress

- Female vs Male
  - Recovery time
  - Symptom Severity
  - Number of symptoms

- Children and adolescents take longer to recover
  - Larger head to body ratio
  - Weak neck muscles
  - Increased vulnerability of the developing brain

- Traumatic brain injuries are treatable!!
Concussion Symptoms

- **Physical**
  - Headache
  - Ringing in ears
  - Blurry vision
  - Nausea
  - Neck pain
  - Dizziness

- **Emotional**
  - Sadness
  - Anxiety
  - Depression
  - Personality changes
Concussion Symptoms
(continued)

• **Cognitive**
  • Confusion
  • Feeling slowed down
  • Memory loss
  • Difficulty thinking clearly
  • Slowed speech

• **Sleep**
  • Feeling exhausted
  • Trouble falling asleep
  • Drowsiness
  • Sleeping less than usual
Healthcare burden of TBI in United States

- Places substantial burden on the health care system
- Yearly U.S. direct and indirect medical cost = $77 Billion
- By 2031 TBI will be the most prevalent neurological condition
- Indirect economic costs due to working-age disability will increase and will be greatest for hospitalized traumatic brain injury (rising from $7.3 billion in 2011 to $8.2 billion in 2031)

PHAC, 2014
TBI at Work

• Large percentage among seriously or fatally injured workers
• Tremendous need to increase employment opportunities, workplace accommodations, technologies, and policies!
• Employment can make enormous difference in lives of people with a brain injury and their families
TBI Awareness

- Invisible disability
- Stigma
- Can be lifelong: considered a chronic condition
- Need for long term support for individuals/families
- Can be risk factor for other conditions, for example Alzheimer’s Disease, seizures, unemployment, social isolation, and suicide
Epidemiology of work-related traumatic brain injury: A systematic review
Chang V, Guerriero N, Colantonio A (2015)

- Searched electronic databases (e.g. Medline)
- 98 studies from worldwide literature were included, 23 specifically focused on work-related TBI
- Estimates of burden (incidence, proportion of occupational injuries or TBI), demographics, injury characteristics, outcomes
The Numbers on Work-Related TBI...

- Based on worldwide estimates, approximately 2-24% of all TBI incidents are work-related. NeuroRehabilitation, 21(4), 269-278.
- In the US, the proportion of TBI’s that are work-related range from 4-14%.
- In Ontario, 7.3% of TBI related cases identified from the Ontario Trauma Registry are work-related.
The numbers cont’d

• TBI accounts for a large proportion of severe and/or fatal work-related injuries:
  • **20%** of traumatic occupational injuries and **60%** of work-related deaths in Washington State involved TBI  
  • TBI contributed to approximately **half** of all workplace fatalities in Ontario  
    *(Brain Injury,20(7),719-724)*
Annual number of claims for TBI involving time off work increased steadily from 790 (0.8%) in 1996 to 1,644 (3.0%) in 2012 (Workplace Safety & Insurance Board, 2012)

• Total time off claims decreased over this time frame

• Large proportion of work-related TBI’s are mild

• In Ontario, there is an increasing trend in the number of concussions (mild/moderate TBI) vs intracranial injuries (e.g. cerebral hemorrhage)

• In the US, concussions account for approx. 90% of non-fatal work-related TBI (Bureau of Labor Statistics, 2012)

• Of the work-related injury fatalities in the United States, 60% involve TBI
Industries Affected

- Primary industries
  - Agriculture, forestry, fishing, mining
  - Highest mortality rate in US and Ontario (Brain Injury 20(7), 719-724)

Farm safety is one of the most important issues facing farming in Ireland today. 23 people including 5 children have died in 2014 alone.
Industries Affected

- Transportation & storage
  - Highest rate when all injury severity levels are included
  - Equally high for men and women
Industries Affected

• **Manufacturing**
  • Accounts for high percentage of mild work-related TBI (*Brain Injury*, 29(11):1362-1369).

• **Service Industry**
  • Government and related services
    • Healthcare and social service, business, sales, finance, and services
  • High frequency of mild TBI
  • Higher rates among women (*Sleep Medicine Reviews*, 25, 52-73)
Traumatic brain injuries in the construction industry

- Construction industry ranked among the top in terms of:
  - Number and rates of severe/fatal work-related TBI
  - High claim costs and long layoffs
  - Males have higher risks
- Mechanism of injury:
  - Older workers: falls
  - Younger workers: struck by/against
- Temporal trends:
  - Most work-related TBI occur in the summer, second peak in October
  - Highest number of injuries in the morning for younger workers/older workers injured in the p.m.
Examining the epidemiology of work-related traumatic brain injury through sex/gender lens: An analysis of workers’ compensation claims in Victoria, Australia

Chang V, Ruseckatie R, Collie A, Colantonio A (2014)
The sex/gender difference with a traumatic brain injury

**Males**
- Median age at injury: 37
- Injury mechanism: struck by/against and Fall from elevation
- Higher pre-injury income
- Higher claim cost
- Duration of work incapacity (mean) = 68 days

**Females**
- 36.4% work-related TBI (n=4186)
- Median age at injury: 40
- Injury mechanism: Struck by/against, falls, and MVAs
- Lower pre-injury income
- Lower claim cost
- Duration of work incapacity (mean) = 41 days

*Occup Environ Med. 2014 Oct;71(10):695-703*
Incidence of work-related traumatic brain injury among A) all workers and B) full-time workers, Victoria, Australia, 2004-2011 (n=4186)
Conclusion

• Need for approaches to prevention tailored to sex/gender considerations, industry, occupation
• Education is needed about the nature of re-injury after TBI
Return to work after work-related traumatic brain injury

Objectives

• Employment loss can negatively impact self-identity, autonomy, and emotional well-being
• Return to work (RTW): important goal in the rehabilitation process
• Study objectives:
  • Compare patient profile of injured workers following TBI who have RTW to those who haven’t
  • Identify RTW facilitators and barriers including demographic, clinical, psychosocial, environmental, and occupational factors
Methods

• Retrospective cohort study 2016
• Participants (age: 18-65) recruited from TRI’s Neurology Services in 2010 who underwent a comprehensive assessment after referred to the Workplace Safety and Insurance Board (WSIB)
• Telephone interview, with mail-in option
Results

• Socio-demographic characteristics

- Mean age: 44.5 (SD 11.9)
- Gender: 64% male
- Marital status: 70% married
- Education: 34% high school or less, 66% > high school
- Return to work: 50% mostly to same employer
Socio-demographic characteristics cont’d

• **Persons returning to work:**
  - Were significantly younger (p<0.05)
    - Mean age 40.8 years (SD 12.8) vs (SD 10.2)
  - More education:
    - 20% with high school or less RTW vs 48% no-RTW
  - No significant gender difference: gender, marital status
Perceived facilitators of RTW (n=25)

1) Support from family/friends – 92%
2) Support from treatment providers – 80%
3) Job modifications/employer accommodation – 76%
4) Medication use – 72%
5) Partial recovery from injury – 72%
6) Support from co-workers – 68%
7) Workplace commitment to health and safety – 64%
8) Early contact from employer – 48%
9) Access to RTW planners/coordination – 44%
10) Supervisor trained in RTW planning – 44%
Traumatic brain injury in the workplace: Innovations for prevention

Methods

• Participants (n = 91) were prospectively recruited from a large, urban teaching hospital in Ontario, Canada
• Participants were referred to the hospital for persistent symptoms related to head and/or brain injury
• They completed an in-depth questionnaire designed to understand the following:
  • Nature and cause of the injury
  • Preventability of the injury
  • Perceived adequacy of job and health & safety training
## Results & Discussion

Profiling training and perceived preventability: preliminary findings

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<thead>
<tr>
<th>Variable</th>
<th>Percent</th>
<th>Total</th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>Job Training</td>
<td>75.3%</td>
<td>71.8%</td>
<td>80.0%</td>
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<tr>
<td>Health and safety training</td>
<td>59.1%</td>
<td>56.8%</td>
<td>62.9%</td>
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<tr>
<td>Injury perceived to preventable</td>
<td>80.0%</td>
<td>80.0%</td>
<td>80.0%</td>
<td></td>
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<tr>
<td>Advised to rest after injury</td>
<td>82.4%</td>
<td>84.6%</td>
<td>80.6%</td>
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<tr>
<td>Advised to take time-off after injury</td>
<td>73.9%</td>
<td>76.3%</td>
<td>72.2%</td>
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</tbody>
</table>
- Most injured workers believed their injuries to be preventable.

- A considerable minority of study participants did not receive job or health & safety training or instruction to take time-off or rest after their injury.
Implications

1. Prevention initiatives should ensure training is universally provided to all employees.
2. Re-injury may be avoided by ensuring workers receive the appropriate rest prior to resuming vocation training.
3. Brain injury education may also help prevent work-related TBI.
Return to work challenges following a work-related mild traumatic brain injury: The injured worker perspective

When a MTBI is work-related, RTW is characterized by several distinct features

I. Workers typically return to pre-injury workplace following a work-related MTBI
II. Tensions in the workplace may escalate if employers face increased costs following an occupational injury
III. The legitimacy of an injury claim might be questioned
IV. Injured workers could return to the workplaces where unsafe hazards and practices have not been addressed
V. When a MTBI takes place in the workplace, the injury is a public event and eliminates the individual’s choice whether to disclose a brain injury, a stigmatizing condition that can have negative effects on one’s career
Recommendations

• Increasing knowledge of employers, co-workers and workers’ compensation representatives related to physical, cognitive, and psychosocial impairments resulting from MTBI so injured workers can receive appropriate support, and mitigate discrimination, stigmatization and re-injury.

• Structural and social elements of workplace and compensation environments should inform strategies to break down barriers to successful return to work following a work-related MTBI.

• Greater focus on preventing re-injury following a work-related MTBI.
Treatment of TBI
Treatment

- 72 hours of physical and mental rest
- Low level exercise maybe started
- “CAVE THERAPY” no longer recommended
- Symptom management
  - Medications, sleep, and diet
  - Hormone replacement therapy
- Physical therapy/speech therapy
- Education
- Return to work
Diet, ketones, and Neurotrauma

*Epilepsia.* 2008 Nov;49(8)111-113

- Treatment options are still being established
- Dietary approach is a therapeutic option
- TBI is a glucose/energy deficit = **CELL DEATH!!**
- Fasting/High fat-low carbohydrate diet slowed cortical tissue preservation, improved cognitive outcome and decreased free radical damage
- Ketones an alternative substrate for neuroprotection
Treatment of TBI: Is there a place for Hormone Replacement

- Neuroendocrine dysfunction has long been a consequence of TBI
- Poorly recognized by physicians
- Incidence rate considering all degrees of hypopituitarism is from 15-90%
- Post-traumatic Neuroendocrine abnormalities occur early and with high frequency which could have significant implications for recovery and rehabilitation (Dept. of Endocrinology Beaumont Hospital)
Estradiol Treatment

- Promotes neuronal growth by decreasing inflammation and boosting the growth of dendrites (Endocrinology, 2004 Dec;145(12):5471-5475)

- Suboptimal levels of estradiol are associated with lower scores on standard assessment of cognition in both men and women (Neurobiol Aging, 2007 Feb;28(2):171-8)

- Postmenopausal women with higher levels of endogenous estradiol also have better semantic (long-term) memory (Neurobiol Aging, 2012 Mar;33(3))
Testosterone Therapy

- “In a study of over 500 aging men and women optimum testosterone levels where linked with better performance on the Mini-Mental Status examination” (Biochem Biophys Acta. 2010 Oct;1800(10):1145-52)

- Testosterone levels are positively associated with multiple aspects of cognitive function (Endocrinol Metab 2002 Nov;87(11):5001-7) (J Clin Endocrinol Metab 1999 Oct;84(10):3681-5)

- Recovery of TBI is greater in those with higher testosterone levels (Brain Inj. 2007 Jan;21(6):645-9)
Progesterone and Vitamin D

- Progesterone protects and heals brain tissue (Prog Brain Res. 2009;175:219-37)
- Progesterone and vitamin D preserves spatial memory/environment (Dept. of Emergency Medicine Emory Univ)
Summary

- Silent epidemic
- MTBI ‘s are treatable
- Education and awareness
- Support = RTW!
Thank you