



TBI Treatment Development Meeting

February 19, 2015 • Washington, DC

Traumatic Brain Injury State of the State

Geoffrey Ling, MD, PhD

Director, Biological Technologies Office, DARPA

Professor of Neurology, USUHS

Attending Physician, Johns Hopkins

TBI Incidence in USA and Globally

United States (CDC)

- Yearly 1.7 million people sustain a TBI
 - 52,000 deaths (3%)
 - 275,000 hospitalizations (16.3%)
 - 1,365,000 are treated and released from an emergency department (80.7%)
- 75% of TBIs are concussions
- M>F
- Under-reported by 10X

Globally (WHO)

- Yearly 10 million people sustain a TBI
- M>F
- Under-reporting due to the absence of injury surveillance or reporting systems
- No internationally accepted method of defining severity and longevity of TBI

CDC, 2012

WHO, 2012

Tragedy of TBI

- Young adults are the highest risk group
 - Most productive members of society
 - Leading cause the death and disability
- TBI: M >> F, children < 4yo, adolescents 15-19yo, older adults > 65yo
- Costs of care are in the \$Billions
 - TBI: \$43.3 Billion/year
 - Does not include costs of lost wages, etc

If TBI has been around for so long then and is so common, then why is it so prominent now?

TBI and Iraq and Afghanistan Wars



DoD Numbers for Traumatic Brain Injury Total Worldwide TBI Diagnoses



Source: Defense Medical Surveillance System (DMSS), Theater Medical Data Store (TMDS)

Prepared by MHS Office of Strategic Communications

Updated 13 Feb. 2013

**Total : 266, 810
(2001-2012)**

Source: DVBIC and AFHSC

State of Civilian TBI Care

- Greatest advances are Clinical Practice Guidelines (CPG) for moderate-severe TBI developed by AANS and CNS and Return to Play/Work by AAN
 - First published in 1995
 - Third edition in 2007
- Mild TBI/Concussion care is inconsistent
 - Only 10-15% of mild TBI victims seen by MD
 - Most are seen by lay person (coach, parent, etc)
 - Epidemiology is incomplete
- **No standard approach** to mild TBI treatment
- **No effective neuro rescue medications** in clinical practice

Military Medical Care System Created

- Creation of the first large system-wide approach to concussion
- Concussion diagnostic tool being used widely by first providers
 - MACE (military acute concussion evaluation)
- Clinical practice guidelines (CPG) for TBI care
 - DoD-VA CPG mTBI/Concussion
 - Guidelines for the Field Management of Combat Related Head Injury
 - Use of civilian CPGs for moderate to severe TBI
 - Additional advances made through war experience
- Clinical guidelines for return to duty (or play)
- Neuro Teams (neurosurgeon and neurointensivist)
- Neurosurgical advances in hemicraniectomy, endovascular techniques and neuro critical care

“There is always room for improvement”

Ling et al, Explosive blast neurotrauma, J Neurotrauma 26:815 (2009)

Knuth, Letarte, Ling et al, “Field management of combat related head injury,” Brain Trauma Foundation (2005)

Cifu, Labutta and Ling (eds), “VA/DoD Clinical Practice Guidelines for Management of Concussion/mTBI” (2009)



TBI Treatment Development Meeting · February 19, 2015

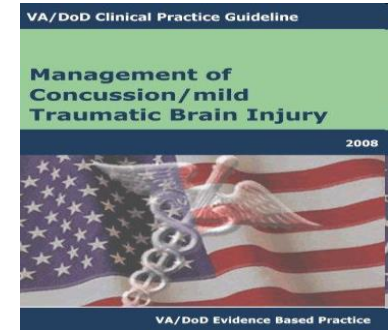
Critical Elements of Early Care

- Screen for TBI w/in 24 hours and remove from duty
- Sleep hygiene
- Symptoms management
- Determine and address any combat stress issues
 - Close coordination and co-location of Combat Stress Team
- Daily 1:1 with provider (OT)
 - Cognitive exercises
 - Education
- Graded return to full physical activity
- Mandatory recovery time
- RTD only if symptom free on no medications

Clinical Management of mTBI

First large system-wide CPG

- VA/DoD Clinical Practice Guidelines for Management of Concussion/mTBI
 - Evidence based
- Focused on **symptoms treatment**
 - Pharmacologic and non-pharmacologic



Cifu, Labutta and Ling (eds),
“VA/DoD Clinical Practice Guidelines for Management of
Concussion/mTBI” (2009)

Download free at:

www.mirecc.va.gov/docs/visn6/VADoD_CPG-Concussion-mTBI_march09.pdf

Battlefield Treatment



Knuth, Letarte, Ling, Moores et al
Brain Trauma Foundation (2005)

Download available: www.braintrauma.org

Key Pre-Hospital Guidelines for Severe TBI

- ABC: O₂sats > 90%, SBP >90%, secure airway
- Determine **GCS and pupil function** as soon as possible
- Triage GCS 9 – 13 to CSH
- GCS < 14 should not return to duty until normalized
- **Sedation and analgesia as needed for transport**
- Analgesics in small doses with proper monitoring
- Antibiotics for penetrating TBI is an option

Clinical Management of Moderate – Severe TBI

“Guidelines for the management of severe traumatic brain injury”
The American Association of Neurological Surgeons
J Neurotrauma 24 Suppl 1: p. S1-106 (2007)
Download available: www.braintrauma.org

Key Guidelines

- ICP < 25mmHg
- CPP > 60mmHg
- SBP > 90mmHg
- pO₂ > 60mmHg or O₂ sats > 90%
- Head of Bed at 30°
- Antiepileptic drug for 7 days (begin w/in 24 hours)
- pCO₂ 34-36mmHg if hyperventilating for herniation
- Hypertonic resuscitation fluids (NS or higher)
- HCT >28
- Artificial airway for GCS ≤8
- Maintain normothermia
- **No** steroids

AANS, J Neurotrauma **24 (suppl 1): S1** (2007)

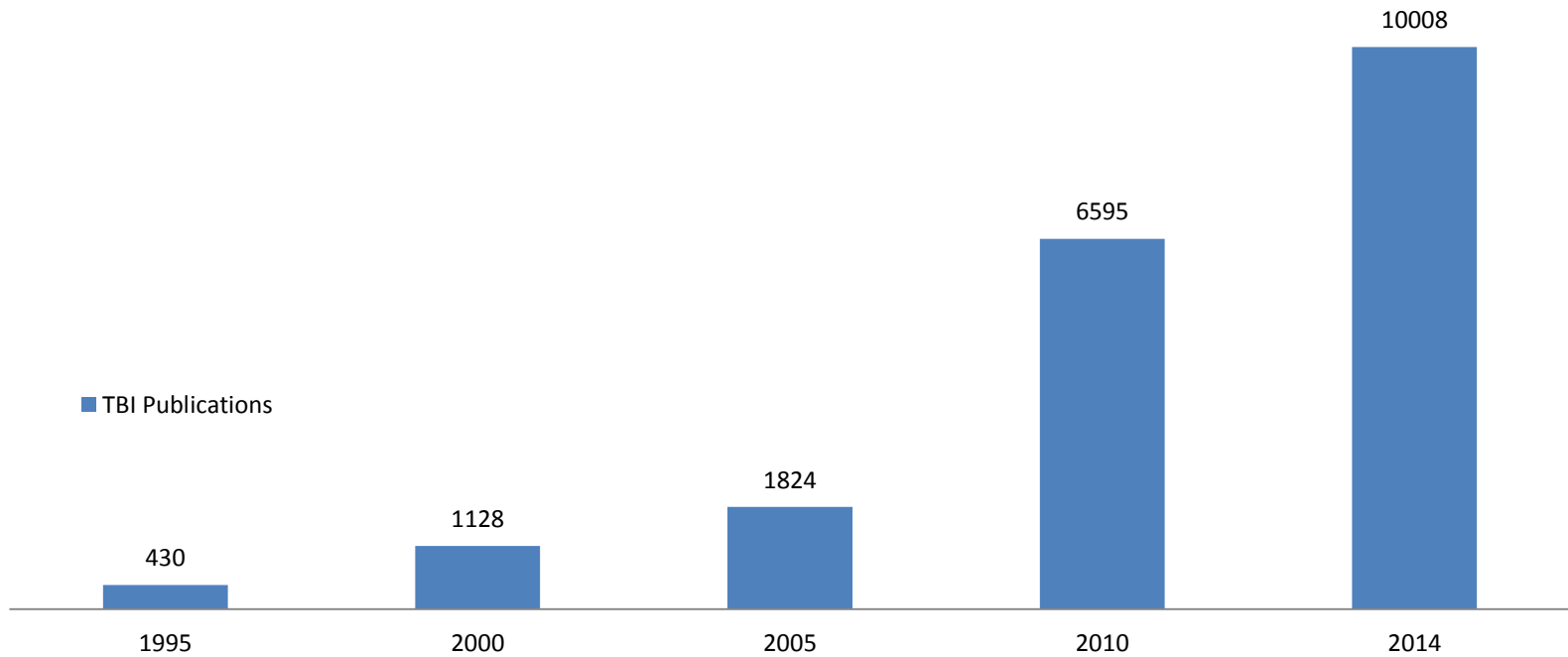
New Drugs?

New Diagnostic tools?

Hope springs eternal

- DoD is heavily investing in TBI (>\$1Billion)
 - Diagnostic devices
 - Biomarkers
 - Neuroprotection agents
 - Imaging techniques (ex. DTI-MRI)

TBI Publications



There is now a legal mandate to
identify TBI

Concussion Laws

- All 50 states and DC have existing state laws
- Washington State was the first
 - Lystedt law based on the tragic death of 14yo Zachary Lystedt who died after suffering multiple concussions during the same football game.

What is in the law

- Varies from state to state
- Common elements
 - Remove from play *immediately*
 - See a medical professional
 - Get “written authorization” before return to play

Conclusion

- TBI is a serious medical condition that afflicts all ages, races and both sexes
- Need a better understanding of the fundamental biology and biophysics of TBI
- Need better epidemiology, esp of mild TBI
- Need better protection mitigation strategies
- Need for clinically effective medications
- Need for diagnostic tools
- Need for improved rehabilitation and recovery strategies

“hope springs eternal”