



Traumatic Brain Injury Overview of Complex TBI

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SCOPE OF THE PROBLEM

Epidemiology

- Incidence
 - 2.5 Million Emergency Department visits-Hospitalization-deaths/year
 - 80-87% d/c from ED
 - 11-16% hospitalized
 - 2% Die
- Prevalence
 - 3.2 – 5.3 million*
 - National estimate based on data from 2 states
- 52,000 fatalities/year



Age at Injury

- Increased risk for
 - Age 0-4, 15-19 and ≥ 75
 - ≥ 75 years of age
 - Highest hospitalized rate
 - Highest mortality
 - Greater disability
 - Male : Female = 60:40
 - Distribution nearly equalizes in the elderly
 - Men are from Mars



Cause of Injury

- Traffic related
- Falls
 - Increased incidence with advancing age
- CDC data reports falls as most common cause
- Recreational
 - Sports
 - Chronic Traumatic Encephalopathy
- Blunt trauma
- Assault
 - More common in urban areas
 - Less than falls, traffic related and blunt trauma
 - < traffic, falls, blunt trauma

Military Service

- Etiology
 - Similar to other populations
 - Blast exposure
 - DoD estimate: 235K from 2000-2011



Mortality trend

- Decreasing
 - Better adherence to Guidelines
 - Fewer motor vehicle crash related deaths

Epidural Hemorrhage

- Epidural space is a potential space between the skull and dura

TBI RELATED COMPLICATIONS

Cognitive and behavioral impairments set those with brain injury apart from others we treat in PM&R

Behavioral Disorders

- Depression
- Agitation/Aggression

Depression

- Sometimes difficult to recognize
- Treatment
 - Psychotherapy
 - Preserved insight and cognitive skills
 - Avoidance of tricyclic antidepressants*
 - SSRI/SNRI
 - Psychostimulants
 - Methylphenidate



Other psychiatric disorder

- Pseudobulbar affect
- Anxiety
- Psychosis

Sleep, Fatigue and Cognition

- Altered sleep patterns
 - Reversal
 - Insomnia
 - Initiation
 - Maintenance
 - Non-restorative
- Observe
 - Self report often inaccurate



Aggression



Post-Traumatic Seizures

- Early
 - Occurs within 1 week of trauma
 - Increased risk with associated
 - Intracranial hemorrhage
 - Penetrating injury
 - Depressed skull fracture with focal neurological impairment
- Late
 - Occurs later than 1 week after trauma



Late Post-Traumatic Seizures

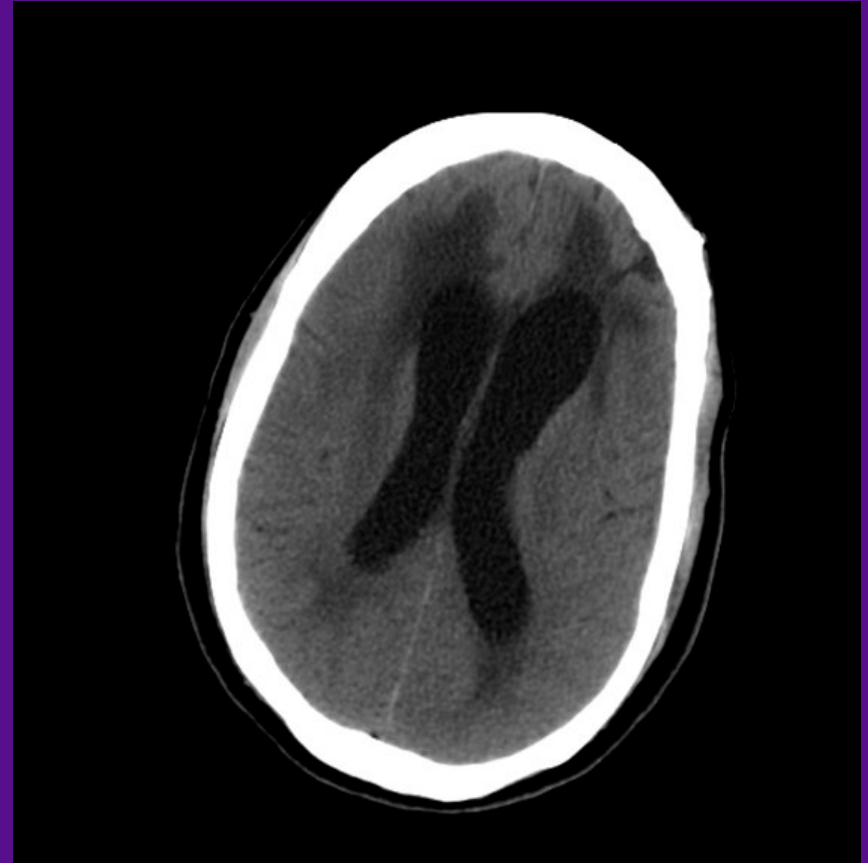
- AANS/Brain Trauma Foundation Guidelines
 - Level II Evidence:
 - There is no indication to provide routine prophylaxis for late post-traumatic seizures
 - Option:
 - It is an option to provided prophylaxis for early post-traumatic seizures
 - No Class I evidence supporting it's long term benefit
 - Based on expert opinion

Hydrocephalus

- Classic Triad NPH*
 - Urinary incontinence
 - Dementia
 - Ataxia
 - i.e.: wet, wacky, and wobbly
- Suspect TBI-related hydrocephalus when
 - Patients do not progress as expected
 - Often associated with hx of SAH, IVH or meningitis

Hydrocephalus

- Diagnosis
 - Neuroimaging
 - Enlarged ventricles
 - Periventricular edema
 - Effaced Sulci
- CSF Tap Test

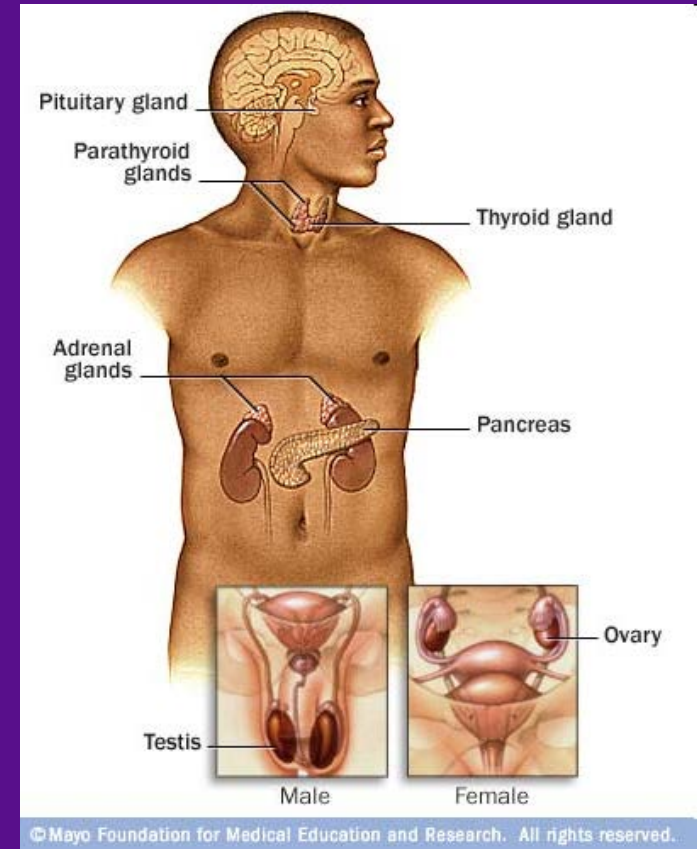
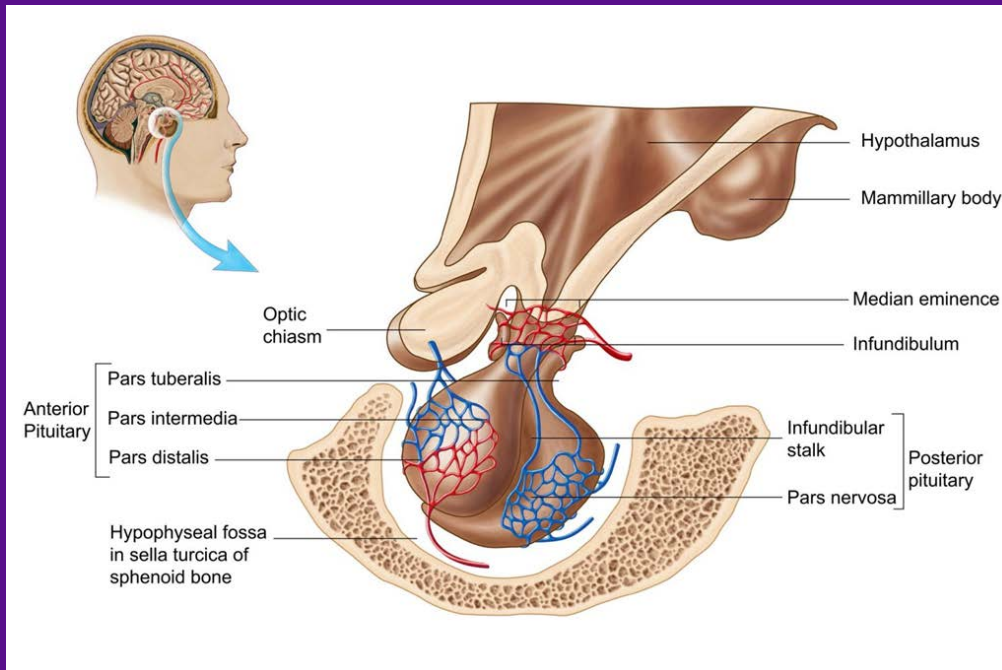


Not Hydrocephalus

- Atrophy
 - Large Ventricles but large sulci as well
 - No periventricular edema
- This is cerebral atrophy or “hydrocephalus ex-vacuo”



- # Pituitary Dysfunction
- Growth Hormone
 - Thyroid
 - Sex Hormones
 - Cortisol



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Heterotopic Ossification

RUSK REHABILITATION

- Occurs most commonly at
 - Elbow
 - Hip
 - Shoulder
 - Knee
- Metaplasia of mesenchymal cells
- Dx
 - Clinical findings
 - Radiography
 - High alkaline phosphatase
 - Ultrasound
 - Bone Scan

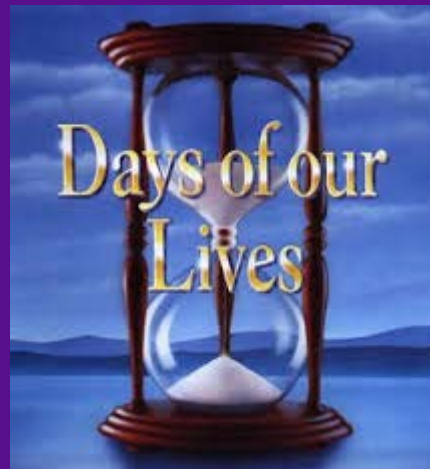


Heterotopic Ossification

- Treatment
 - Etidronate sodium
 - NSAIDs
 - Surgery
 - Timing controversies

Disorders of Consciousness

- Coma
 - Eyes closed
 - No sleep wake cycles
- Short lived
 - Die or emerge into another level of consciousness



Level of Consciousness

- Vegetative State
 - Eyes are open
 - Preserved vegetative functions
 - e.g. sleep-wake cycles
 - No clinically apparent purposeful or voluntary response to internal or external stimuli

Minimally Conscious State

- Evidence of voluntary activity
 - Follows commands
 - Must account for level of difficulty
 - Visually tracks
 - Responds to questions
 - Accuracy of response unimportant
 - Effective communication heralds emergence from minimally conscious state

Emergence from DOC

- Over time more likely from Traumatic vs. non-traumatic etiology

Traumatic Brain Injury as a Chronic Health Condition

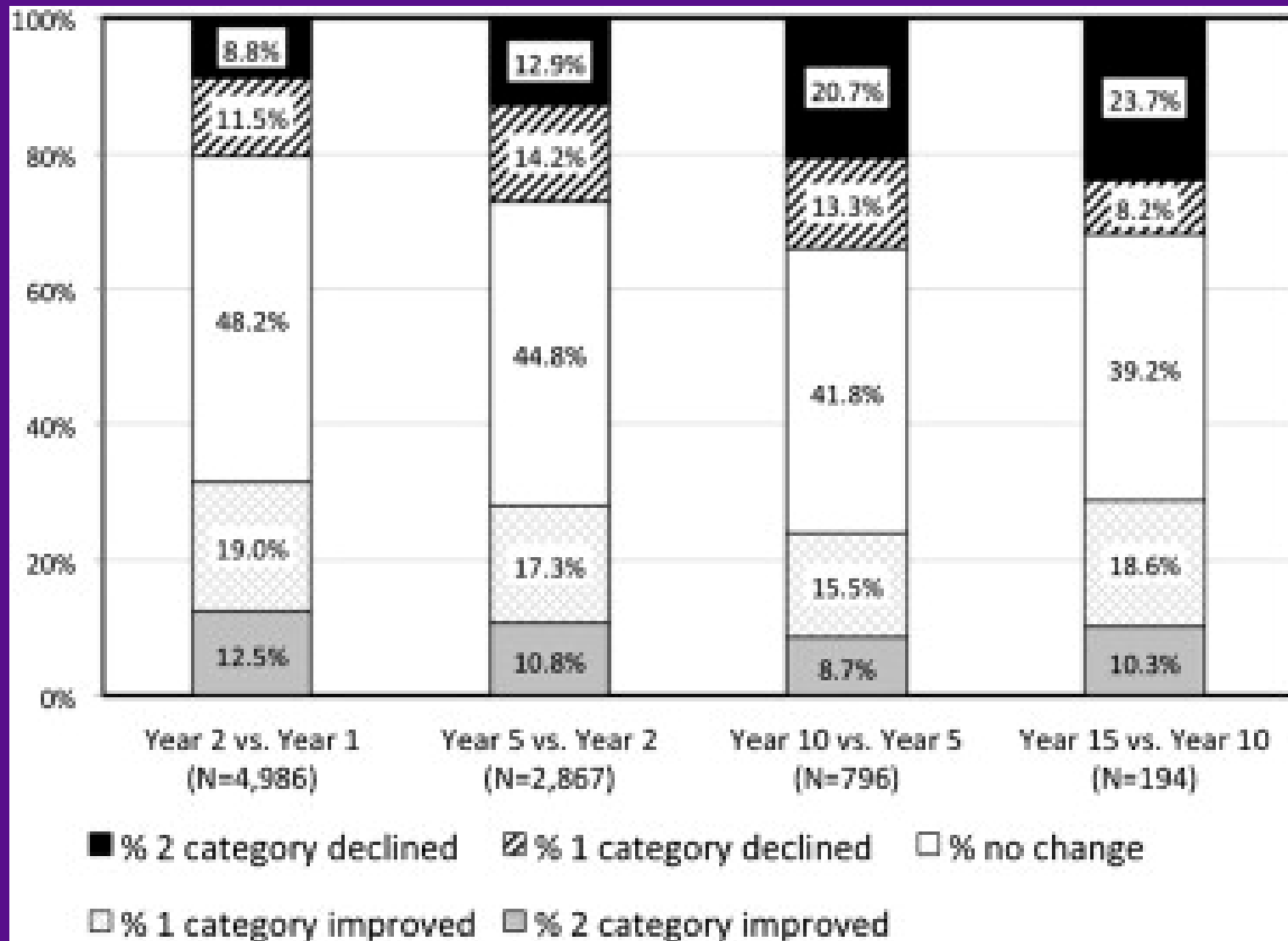


Fig 1 One- and 2-category change in Glasgow Outcome Scale-Extended score 2 to 15 years after TBI.

John D. Corrigan, Flora M. Hammond

Archives of Physical Medicine and Rehabilitation, Volume 94, Issue 6, 2013, 1199 - 1201

<http://dx.doi.org/10.1016/j.apmr.2013.01.023>

Long-term Mortality: Hospitalized Sample

- General Findings
 - Mortality 2-3x general population
 - Injury severity predominantly moderate to severe with some mild
 - Recent evidence suggest
 - 9 year reduction in life expectancy
 - 2.23 x more likely to die than general population
 - Harrison-Felix et al. J Neurotrauma 2014
 - 4.11 reduction moderate TBI/ 13.77 severe TBI. No reduction post mild TBI.
 - Groswasser Z et al. Brain Inj 2018

TBI and Health Problems

- Veteran's study
 - Retrospective study 189K veterans age > 55 (baseline and follow up)
 - Vets with TBI slightly younger than those without TBI
 - TBI had greater prevalence of
 - Diabetes
 - Hypertension
 - Coronary Artery Disease
 - Cerebrovascular Disease
 - Depression
 - PTSD

Barnes DE et al. Traumatic brain injury and risk of dementia in older veterans. Neurology 2014

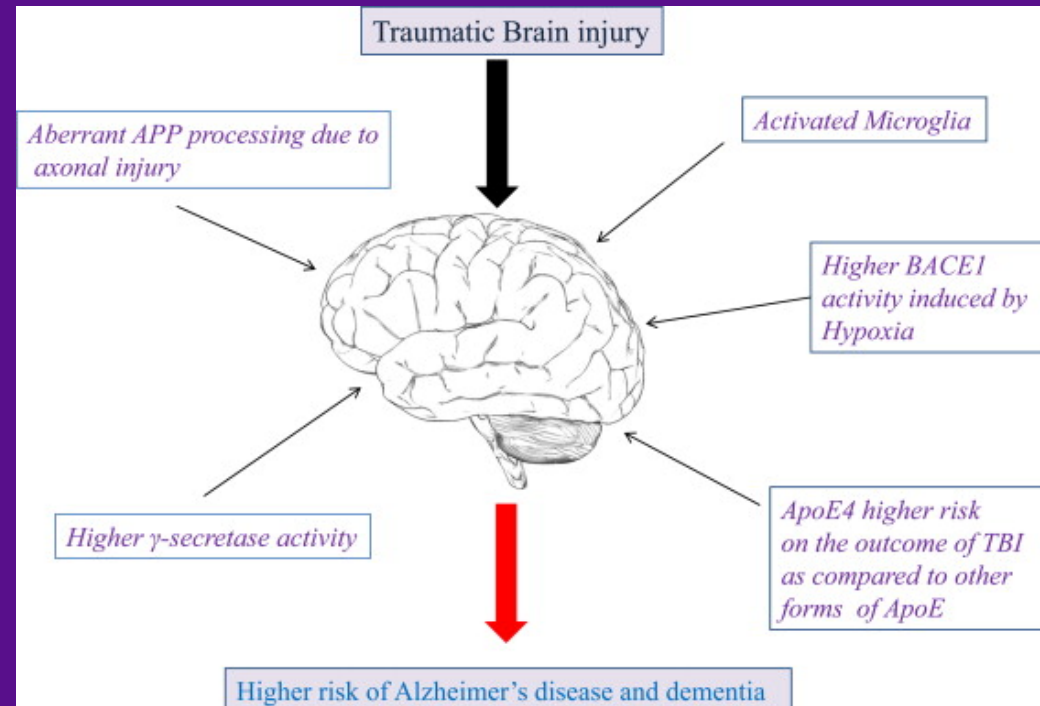
NEURODEGENERATION AND TBI/CONCUSSION

Well established association?

What's the evidence?

TBI-related pathology

- Possible contributing mechanisms to neuro-degeneration
 - Hyper-phosphorylated tau/NFT
 - A β deposition
 - Hypoxia-related changes in gene expression
 - Injury-related vascular changes
 - Upregulation of inflammatory markers



Sivanandam TM et al. Neurosci Biobehav Rev 2012

General Conclusion: TBI Neurodegenerative Condition

- Many epidemiological studies provide compelling evidence that sustaining a TBI is associated with increased risk for degenerative conditions that may result in dementia including AD; however, other high-quality epidemiological studies have demonstrated no increased risk for dementia following TBI.
- Studies on the risk for dementia following TBI are very difficult to compare due to differences in study design, duration of follow-up, operational definition of both TBI and dementia, and differences in the extent to which other dementia risk factors are controlled.
- Evidence suggests TBI-related dementia may be a neurodegenerative condition distinct from AD
- Many lingering questions regarding Chronic Traumatic Encephalopathy

Questions?

