Traumatic Brain Injury in Older Adults

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Speaker disclosures

I HAVE NO CONFLICTS OF INTEREST

I HAVE GRANT FUNDING SUPPORT FROM NIH, CDC

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Objectives

- Describe trends in geriatric TBI prevalence and etiology
- Identify aging-related changes that may influence TBI and related outcomes
- Discuss initial care and symptom management for older adults with TBI

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Trends in Gerotrauma

- Older adults constitute ~13% of the population, but represent almost ~25% of trauma admissions
- Older adults' injury and hospitalization rates are increasing, even after adjusting for population growth
- Unintentional injury is the 4th leading cause of death in persons 55-64 and those 65+ (CDC, 2021)

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TBI in Older Adults Mechanism of Injury

- Falls*
- MVC and Traffic Incidents
- Assault
- Suicide Attempt
- Other

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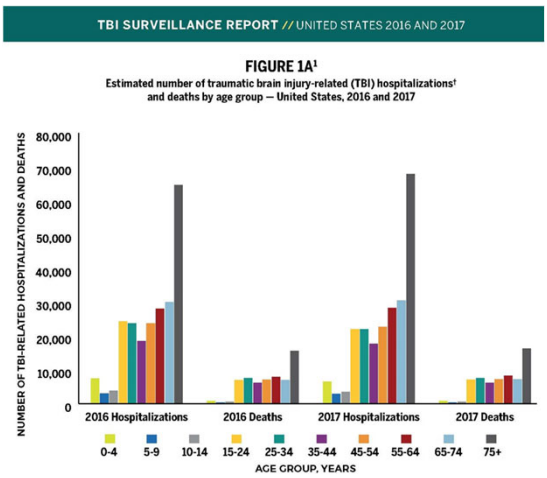
Traumatic Brain Injury

- Age-adjusted rates of TBI in older adults significantly higher than the general population
  - Highest rates of death and hospitalization from TBI
  - Adults aged 65 and older account for more than 45% of all TBI-related hospitalizations
- More than 75% of these are considered "mild"



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Risk Factors for Injury in Older Adults

- Comorbid conditions
  - Frailty
  - Depression
  - Diabetes
  - Syncope
  - Orthostatic hypotension
  - Cognitive impairment (dementia)
  - Vision problems
  - Incontinence
- Alcohol use
- History of Falls

- Medications
  - Biggest risk from:
    - long-acting benzodiazepines
    - psychotropics
    - anticholinergic medication
  - Increased risk with certain Antidepressants
  - Mild increase from:
    - Diuretics
    - Type I Anti-arrhythmics
    - Digoxin

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Outcomes of Older Adults Following TBI

- Higher mortality
- Increased dependence at all severity levels
- Longer lengths of stay
- Neurologic decline at later time points more likely
- Higher cost of care

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Neurologic Changes with Aging: Implications for TBI in Older Adults

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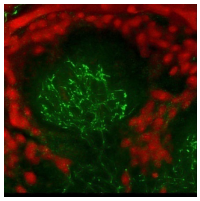
Neurochemical Changes

- Reduction in variety of neurotransmitters
- Reduction in receptor density
- Lower rates of receptor recovery
- Neuromodulatory regulation of receptors



http://www.uni-kl.de/FB-Biologie/AG-Deitmer/Confocal/anti_5HT.html

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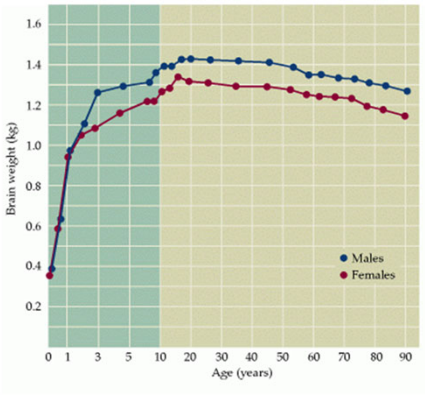
Anatomical Changes

- Neuronal shrinkage=loss of volume
- Modest loss of synapses
- Decreased dendritic length and width
- Loss of dendrites
- Reduction in reactive synaptogenesis
- Structural deterioration of microglia
  - Altered immune function
- Changes in vasculature
  - Vessels vulnerable to rupture
  - Decreased autoregulation



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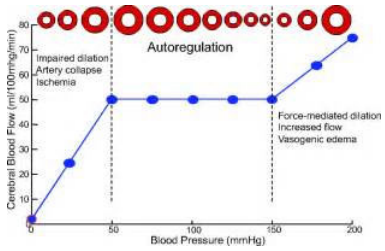
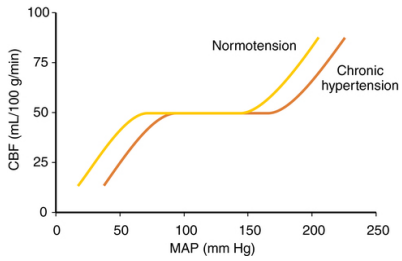
Cerebral Autoregulation

- CBF normally constant due to CA
- Normal regulate b/w CPP 50-100 mmHg
- Trauma changes ability
- Chronic HTN alters the set point as well





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Subdural Hematoma

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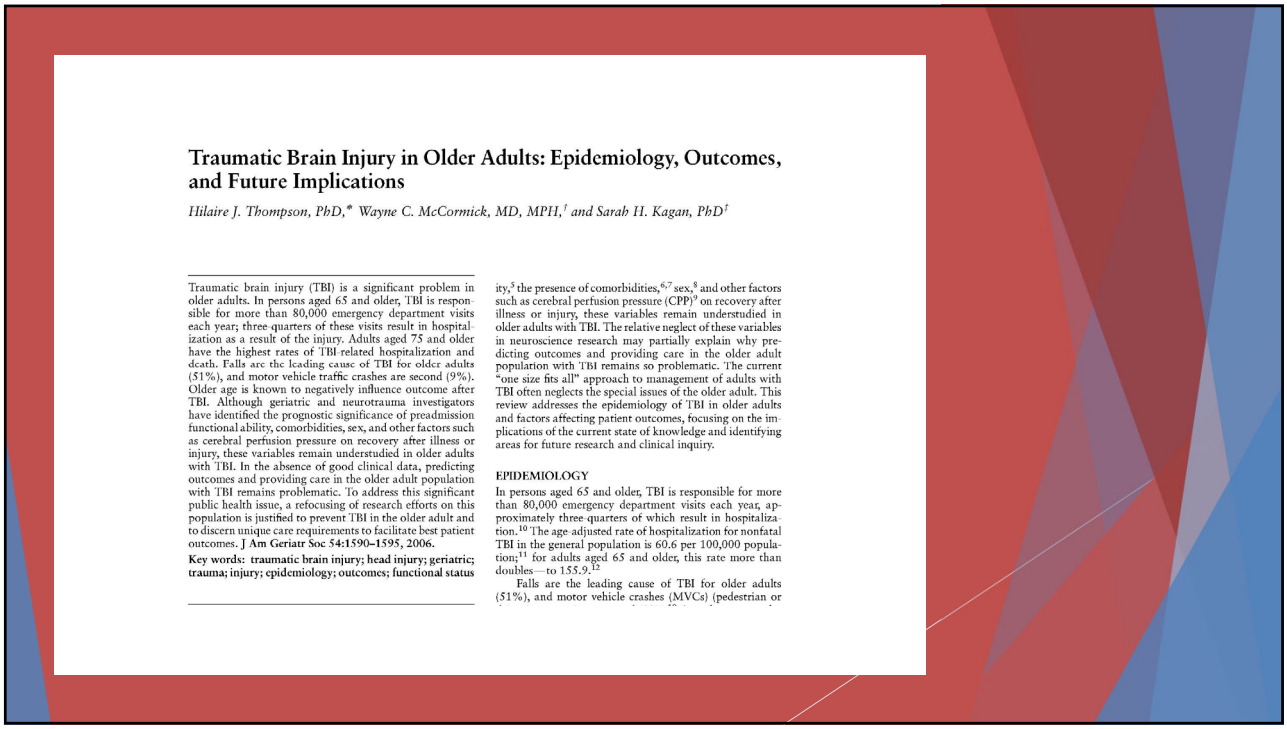

Traumatic Brain Injury in Older Adults: Epidemiology, Outcomes, and Future Implications

Hilaire J. Thompson, PhD, Wayne C. McCormick, MD, MPH,† and Sarah H. Kagan, PhD†*

Traumatic brain injury (TBI) is a significant problem in older adults. In persons aged 65 and older, TBI is responsible for more than 80,000 emergency department visits each year; three-quarters of these visits result in hospitalization as a result of the injury. Adults aged 75 and older have the highest rates of TBI-related hospitalization and death. Falls are the leading cause of TBI for older adults (51%), and motor vehicle traffic crashes are second (9%). Older age is known to negatively influence outcome after TBI. Although geriatric and neurotrauma investigators have identified the prognostic significance of preadmission functional ability, comorbidities, sex, and other factors such as cerebral perfusion pressure on recovery after illness or injury, these variables remain understudied in older adults with TBI. In the absence of good clinical data, predicting outcomes and providing care in the older adult population with TBI remains problematic. To address this significant public health issue, a refocusing of research efforts on this population is justified to prevent TBI in the older adult and to discern unique care requirements to facilitate best patient outcomes. J Am Geriatr Soc 54:1590–1595, 2006.

Key words: traumatic brain injury; head injury; geriatric; trauma; injury; epidemiology; outcomes; functional status

ity,[5] the presence of comorbidities,[6,7] sex,[8] and other factors such as cerebral perfusion pressure (CPP)[9] on recovery after illness or injury, these variables remain understudied in older adults with TBI. The relative neglect of these variables in neuroscience research may partially explain why predicting outcomes and providing care in the older adult population with TBI remains so problematic. The current "one size fits all" approach to management of adults with TBI often neglects the special issues of the older adult. This review addresses the epidemiology of TBI in older adults and factors affecting patient outcomes, focusing on the implications of the current state of knowledge and identifying areas for future research and clinical inquiry.

EPIDEMIOLOGY

In persons aged 65 and older, TBI is responsible for more than 80,000 emergency department visits each year, approximately three-quarters of which result in hospitalization.[10] The age-adjusted rate of hospitalization for nonfatal TBI in the general population is 60.6 per 100,000 population;[11] for adults aged 65 and older, this rate more than doubles—to 155.9.[12]

Falls are the leading cause of TBI for older adults (51%), and motor vehicle crashes (MVCs) (pedestrian or

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Age Biases in Health Care

- Older adults get less aggressive treatments
- Older adults not seen as "candidates" for health promotion programs
- Older adults often excluded from health studies

"Of all the self-fulfilling prophecies in our culture, the assumption that aging means decline and poor health is probably the deadliest."-Marilyn Ferguson

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Undertriage

Correct triage of older trauma patients difficult

- Age-related changes
- Medications
- Comorbidity
- Injury factors

Undertriage increases with age

- Rates reported to be 40-60%

Ohio has developed statewide geriatric triage criteria

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Are we obtaining accurate history?

- 15% of subjects had no data recorded regarding medical history in records
- >80% of patients with a documented history had at least 1 pre-injury condition
- Absence of history and usual medications may delay or complicate diagnosis and treatment in older trauma patients

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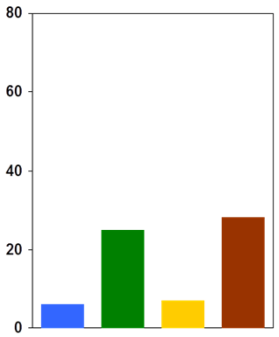
Care Given to Older Adults: Examination After a Fall



- 6% Blood pressure
- 25% Vision
- 7% Gait and balance
- 28% Neurological exam

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Evaluation of the effect of intensity of care on mortality after traumatic brain injury

Hilaire J. Thompson, PhD, RN; Frederick P. Rivara, MD, MPH; Gregory J. Jurkovich, MD; Jin Wang, PhD; Avery B. Nathens, MD, PhD; Ellen J. MacKenzie, PhD

Objectives: To evaluate the effect of age on intensity of care provided to traumatically brain-injured adults and to determine the influence of intensity of care on mortality at discharge and 12 months postinjury, controlling for injury severity.

Design: Cohort study using the National Study on the Costs and Outcomes of Trauma (NSCOT) database. Risk ratio and Poisson regression analyses were performed using data weighted according to the population of eligible patients.

Setting and Patients: A total of 18 level 1 and 51 level 2 nontrauma centers located in 14 states in the United States and 1,776 adults aged 25–84 yrs with a diagnosis of traumatic brain injury.

Measurements: Injury severity was determined by the motor component of the Glasgow Coma Scale score, the Injury Severity Score, pupillary reactivity, and presence of midline shift. Factors evaluated as contributing to intensity of care included: admission to the intensive care unit, mechanical ventilation, placement of an intracranial pressure monitor, placement of a jugular bulb catheter, placement of a pulmonary artery catheter, critical care consultation, the number of specialty care consultations, mannitol use, treatment with barbiturate coma, decompressive craniectomy, number of nonneurosurgical procedures performed, the presence of a do-not-resuscitate order, and withdrawal of therapy.

Main Results: Controlling for injury-related factors, sex, and comorbidity, as age increased, the overall likelihood of receiving various interventions decreased. After controlling for injury severity, sex, and comorbidity, factors associated with higher risk of in-hospital death were: being aged 75–84 yrs (relative risk [RR] 1.32, 95% confidence interval [CI] 1.13, 1.55), pulmonary artery catheter use (RR 1.56, 95% CI 1.30, 1.86), intubation (RR 4.17, 95% CI 2.28, 7.61), the presence of a do-not-resuscitate order (RR 3.21, 95% CI 2.21, 4.65), and withdrawal of therapy (RR 2.33, 95% CI 1.69, 3.23). In contrast, a higher number of specialty care consultations (surgical consults: RR 0.63, 95% CI 0.54, 0.74; medical consults: RR 0.87, 95% CI 0.79, 0.95; and other consults: RR 0.43, 95% CI 0.26, 0.69) were associated with decreased risk of death. The results were similar for factors associated with death at 12 months, with the exception that the number of medical consultations was not significant, whereas the number of nonneurosurgical procedures performed was associated with lower risk of death (RR 0.96, 95% CI 0.92, 0.99), as was obtaining critical care consultation services (RR 0.84, 95% CI 0.71, 1.0).

Conclusions: There is a lower intensity of care provided to older adults with traumatic brain injury. Although the specific contributions of specialists to patient management are unknown, their consultation was associated with decreased risk of in-hospital death and death within 12 months. It is important that careproviders have an increased awareness of the potential contribution of multidisciplinary clinical decision making to patient outcomes in older traumatically brain-injured patients. (Crit Care Med 2008; 36:282–290)

KEY WORDS: head injury; critical care consultation; specialty care consultation; pulmonary artery catheter; older adult

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JOURNAL OF NEUROTRAUMA 29:1864–1871 (July 1, 2012)
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DOI: 10.1089/neu.2011.2284

Utilization and Costs of Health Care after Geriatric Traumatic Brain Injury

Hilaire J. Thompson,[1,2] Sharada Weir,[3] Frederick P. Rivara,[2] Jin Wang,[2] Sean D. Sullivan,[4] David Salkever,[5] and Ellen J. MacKenzie[6]

Abstract

Despite the growing number of older adults experiencing traumatic brain injury (TBI), little information exists regarding their utilization and cost of health care services. Identifying patterns in the type of care received and determining their costs is an important first step toward understanding the return on investment and potential areas for improvement. We performed a health care utilization and cost analysis using the National Study on the Costs and Outcomes of Trauma (NSCOT) dataset. Subjects were persons 55–84 years of age with TBI treated in 69 U.S. hospitals located in 14 states ($n=414$, weighted $n=1038$). Health outcomes, health care utilization, and 1-year costs of care following TBI in 2005 U.S. dollars were estimated from hospital bills, patient surveys, medical records, and Medicare claims data. The subjects were further analyzed in three subgroups (55–64, 65–74, and 75–84 years of age). Unadjusted cost models were built, followed by a second set of models adjusting for demographic and pre-injury health status. Those in the oldest category (75–84 years) had significantly higher numbers of re-hospitalizations, home health care visits, and hours per week of unpaid care, and significantly lower numbers of physician and mental health professional visits than younger age groups (age 55–64 and 65–74 years). Significant age-related differences were seen in all health outcomes tested at 12 months post-injury except for incidence of depressive symptoms. One-year total treatment costs did not differ significantly across age categories for brain-injured older adults in either the unadjusted or adjusted models. The unadjusted total mean 1-year cost of care was $77,872 in persons aged 55–64 years, $76,903 in persons aged 65–74 years, and $72,733 in persons aged 75–84 years. There were significant differences in cost drivers among the age groups. In the unadjusted model index hospitalization costs and inpatient rehabilitation costs were significantly lower in the oldest age category, while outpatient care costs and nursing home stays were lower in the younger age categories. In the adjusted model, in addition to these cost drivers, re-hospitalization costs were significantly higher among those 75–84 years of age, and receipt of informal care from friends and family was significantly different, being lowest among those aged 65–74 years, and highest among those aged 75–84 years. Identifying variations in care that these patients are receiving and determining the costs versus benefits is an important next step in understanding potential areas for improvement.

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Variable	Age 55-64	Age 65-74	Age 75-84	p-value
Number of re-hospitalizations or nursing home stays	0.23(1.31)	0.28(1.16)	0.55(1.55)	$0.03^{\#,\$}$
Number of physician visits related to injury	2.4(10.2)	1.9(4.2)	0.9(2.8)	$0.002^{\#,\$}$
Number of mental health professional visits	0.81(5.46)	0.18(1.47)	0.06(0.65)	$0.04^{\#}$
Receipt of paid home health care: # weeks receiving home health	0.08(0.94)	0.26(1.41)	0.66(2.04)	$<0.0001^{\#,\$}$
Receipt of care from friends or family: average number of hours on unpaid care/week	1.5(6.6)	2.2(7.6)	3.5(10.1)	$0.02^{\#,\$}$

Health Care Utilization

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Clinical Management

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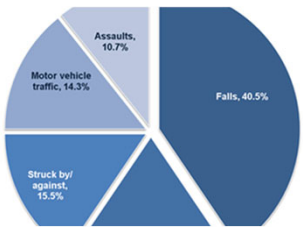
Management Begins with Prevention

- Fall prevention
  - Exercise
  - Home Safety
  - Appropriate shoes
- Driving safety
- Helmet use
- Review medication regularly
- Vision checked regularly



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Primary vs. Secondary Injury

- Primary Injury is direct result of initial traumatic event
- Progressive damage occurs following the initial injury and can be increased by additional injury or mitigated by appropriate treatment

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Initial Assessment

- History
- Mechanism of injury
- Duration and severity of alteration in consciousness
- Immediate and current symptoms History of prior head injury
- Confounding or comorbid conditions that may exacerbate concussion symptoms or complicate the concussion recovery process
- Neurologic exam
- Mental status/cognitive testing addressing orientation, concentration and memory
- Assess presence of symptoms at the time of injury as well as exacerbation of symptoms with activity.
- Pupillary assessment
- Coordination (finger to nose test and tandem gait testing)
- Sensation
- Following the initial exam, repeat until return to baseline

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CT Criteria

- Canadian CT Head Rule
  - GCS <15 2H post-injury
  - Suspected open/depressed skull fx
  - Any sign basilar skull fx
  - Vomiting 2x or more
  - Age >65
  - Retrograde amnesia of more than 30 min
  - Mechanism high risk (e.g. ejection)

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mTBI Management

- Should not expect that symptoms will resolve during the initial evaluation period; expected trajectory is gradual symptom resolution within a **couple of weeks**
- No specific drug to treat TBI
- Avoid opioids and sedating meds
- Aspirin, anticoagulants and alcohol may exacerbate symptoms, or prolong recovery
- Resumption of activity should be provided as written instructions
- In the sub-acute to chronic phase following mTBI, assessment and management is symptom triggered and focused

https://www.cdc.gov/traumaticbraininjury/pdf/TBI_Patient_Instructions-a.pdf

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Is it Injury?

Is it Aging?

WHAT IS DIFFERENT ABOUT THE POST-TBI SYMPTOM EXPERIENCE?

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10 Most Prevalent Symptoms Endorsed at 1-week Post-injury by Older and Younger Adults Post-TBI

Younger-prevalent symptoms

1. **Headache** (61%)
   Balance
3. Irritability (56%)
4. Fatigue (50%)
5. Dizziness (50%)
6. **Anxiety** (44%)
   Trouble concentrating
   Blurry vision
   Trouble sleeping
   Taste

Older-prevalent symptoms

1. Balance (73%)
2. Fatigue (67%)
3. Dizziness (60%)
4. Trouble sleeping (53%)
5. **Memory difficulties** (47%)
   Irritability
7. Blurry vision (40%)
   Trouble concentrating
9. **Bothered by light** (33%)
   Taste

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Common Problems: Fatigue

- 2/3 older TBI patients have severe fatigue; can last years
- Secondary causes of fatigue include
  - sleep disorders
  - Pain
  - Depression
  - Anxiety
  - Lifestyle
  - medical conditions (ex. anemia, hypothyroidism)
  - medication side effects
- If acute post-injury period, assess for possible signs of CNS deterioration
- Assess for potential etiology
  - Physical?, psychological?, mental?, mixed?
- Recommend planning, use of daily schedule, prioritization and periods of rest
- Referral for CBT, PT
- Graded aerobic exercise with CBT

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Common Problems: Sleep

- Higher prevalence of many sleep disorders including insomnia, obstructive sleep apnea
- Lack of sleep can exacerbate other symptoms (e.g., pain, cognitive deficits)
- Nonpharmacologic Management
  - Sleep Hygiene
  - CBT-I
- Melatonin may be considered if behavioral strategies fail

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Common Problems: Memory

- Memory impairment is commonly reported symptom but could reflect deficit in other domain such as processing speed
- Screen for risk factors for ongoing memory problems:
  - Previous head injury
  - Multiple trauma
  - Hx alcohol/drug abuse
  - Lower cognitive reserve
  - Lower SES, social support

- Memory interventions
  - Restorative
    Ex. Word-list learning
  - Compensatory
    - Memory book
    - Calendars
    - Technology

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Common Problems: Post-traumatic headache

- Less prevalent in geriatric population
- Avoid giving opioids and benzodiazepines
- Non-pharmacologic therapies (rest, ice/heat, massage, exercise)

- Headache log
- No universal PTH treatment

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Common Problems: Post-Traumatic Neurological Disorders

- Increased risk of developing epilepsy compared to YA post-TBI
  - Delayed seizure presentation more common
  - Newer agents preferable (e.g., levetiracetam)
- May accelerate or increase risk of developing dementia, PD
- New onset depression, PTSD
  - Likelihood declines over time

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Common Problems: Other

- Posture, Balance and Vestibular Symptoms:
  - Prevalence higher in OAs
  - Postural stability may be an indicator of recovery
  - Important to assess
    - Contributions of vision
    - Associated hearing loss
    - Medications for side effects
  - Vestibular/balance therapy
- Visual disturbance
  - Wide range of prevalence reported 2-50%
    - Diplopia
    - Blurry vision
  - Treatment may include:
    - Use of eye patches, sunglasses
    - Management of environmental light
- Olfactory/Taste disturbance
  - Anosmia
  - May impact food intake and result in weight loss
  - Monitor weight
  - Dietary referral

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Thank you!

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