San Francisco VA Epilepsy Center of Excellence:

Epilepsy & Traumatic Brain Injury

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Outline for Day

• VA Epilepsy Centers of Excellence
• Traumatic Brain Injury
  – Background and History
  – Definitions
  – Risk Factors
  – Diagnosis
  – Treatment
SF VA Epilepsy Center

- Established in 1997 to provide Veterans with access to specialized epilepsy care
- Designated as one of four national Centers of Excellence in 2002 by VHACO
- Named as a regional Epilepsy Center of Excellence (ECOE) site by VHACO in 2008
SF VA Epilepsy Center Services

- Outpatient specialty clinics
- Medication management
- Video/EEG Monitoring inpatient unit
- High-resolution neuroimaging (MRI)
- Vagus nerve stimulator
- Epilepsy surgery
Definitions

• Seizures:
  • Electrical disturbance in the brain resulting in over-synchronized and unregulated activity

• Epilepsy:
  • Predisposition or tendency to have seizures, >2 unprovoked
Post-Traumatic Epilepsy

- Epilepsy can result from head trauma
- Seizures may begin hours to years after injury
- Vietnam Head Injury Study: 15 years after penetrating brain injury, up to 53% had seizures
- Animal research suggest blast injury may be also injurious to the brain

Salazar, et al., 1985
Garga & Lowenstein, 2006
Historical perspective

• Hippocrates (460-357 BC)
  – “Injuries of the Head”: …wounds of left temporal region caused convulsions on right side of body
  – Seizures with head injury or surgery

• Renaissance (14th-17th centuries)
  – Descriptions of seizures after head injury

• Underappreciated until late 19th century
  – 1843 French physician Leuret described 67 cases

(Lowenstein 2009, Caveness 1979)
Definitions

• Traumatic Brain Injury Severity
  – **Mild**: Loss of consciousness <30 minutes, no skull fracture
  – **Moderate**: Loss of consciousness of 30 minutes to 24 hours, with or without skull fracture
  – **Severe**: Loss of consciousness >24 hours, with contusion (bruise) or hematoma (bleeding)
Definitions

• Seizure timing

  – **Immediate**: <24 hours after injury
  
  – **Early**: <1 week
  
  – **Late**: >1 week after injury
Causes of Epilepsy

**Figure 1.**
Causes of Epilepsy

• 5-6% of patients seen in specialized epilepsy centers
• TBI in 30% of patients aged 15-35 years
• Severe traumatic brain injury at highest risk for late seizures
  – Prolonged loss of consciousness
  – Bleeding
  – Contusion (bruising)

(Agrawal 2006, Hauser 1993)
5 yr probability
Mild=0.7%
Mod=1.2%
Severe=10.0%

30 yr probability
Mild=2.1%
Mod=4.2%
Severe=16.7%
Lessons from Conflicts

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<th>No. with Fits</th>
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(Caveness 1961)
Lessons from Conflicts

• Vietnam Head Injury Study (VHIS)
  – 1,131 Veterans with penetrating injury were followed for at least 5 years
  – Most had neurosurgical intervention within a few hours
  – After 5 years, incidence of epilepsy was 34%

(Salazar et al. Neurology 1985; 35: 1406)
Lessons from Conflicts

- VHIS results
  - 520 Veterans evaluated after 15 years
  - Overall seizure occurrence was 53% in a subset
  - Penetrating injury

(Salazar 1985)
Relative risks for developing epilepsy

(Herman 2002)
TBI Risk Factors for Epilepsy

- Brain contusion (bruise)
- Hematomas (bleeding)
- Depressed skull fractures
- Loss of consciousness, amnestic period
- Early seizures
Loss of consciousness

- Loss of consciousness or post-traumatic amnesia at time of injury for >24 hours = much higher risk later in life

- 30 minutes to 24 hours = unclear, may depend on type of injury

- Less than 30 min = lower risk
Early seizures

• Non-Veteran Study
  – Early seizures at time of traumatic brain injury modestly increased risk of later epilepsy
  – Children with traumatic injury and early seizures more common

Asikainen 1999
Neurologic Testing

• Brain imaging (MRI and head CT)
  – Fracture
  – Bleeding
  – Contusion (bruising)

• Electroencephalography (EEG)
  – Helpful if abnormal
  – Not specific for traumatic brain injury
Post-traumatic Epilepsy

• Onset
  – Majority of patients will have seizures in the first year or two
  – 15-20% may develop after 2 years
  – >18% after 5 years and 7% after 10 years

Salazar 1985
Post-traumatic Epilepsy

• Types of Seizures
  – Focal onset (one part of the brain)
  – No consistent pattern among multiple studies

• Frequency
  – Variable
  – More seizures associated with longer duration of epilepsy
Treatment

• Prophylactic medications BEFORE seizures?

• Multiple studies in traumatic brain injury, including Veterans

• Results
  – Decreased rate of early seizures
    • Phenytoin, carbamazepine
  – No long term effect on preventing epilepsy
  – No evidence at this point to use prophylactic medications before seizures
Treatment

• AFTER seizures have occurred
  – Medications
    • Very effective
    • Many options
  – Epilepsy Surgery
  – Vagal Nerve Stimulation
Medically Refractory Epilepsy

• Definition: Persistent seizures despite adequate trials of two medications

• 30-40% of patients with focal seizures

• 200,000 patients in US with MR epilepsy are candidates for surgical treatment but only 2-3,000 epilepsy surgeries are performed annually

• Applies to patients with epilepsy due to TBI
Pre-Surgical Work-Up: Refer to Epilepsy Center

- Video EEG Monitoring
  - Determine where seizures are originating
- MRI brain
  - Sensitive imaging
- Neuropsychological testing
- WADA testing (for language)
Current Conflicts (OEF/OIF)

- TBI and Concussive/Blast Injury are signature injury
- ~20% with an event of impaired consciousness
- Joint Theater Trauma Registry: 22% of all returning soldiers with head injuries
- 59% of all Veterans with blast injuries have TBI

Schwab 2007
Impact on Epilepsy

• Estimates of epilepsy risk unknown, wide range
• Nature of Injury
  – Blast, concussive
  – Animal studies
• Mild TBI, PTSD, post-concussive
• Role of National Epilepsy Centers of Excellence

(Okie 2005)
Conclusions

• Traumatic brain injury increases risk of seizures and epilepsy.
• Veterans are at increased risk for both.
• If it occurs, medications do work.
• The impact of the current conflicts probably increases risk.
• The VA and ECOE recognizes this, and are here to help.
SFVA Epilepsy Monitoring Unit