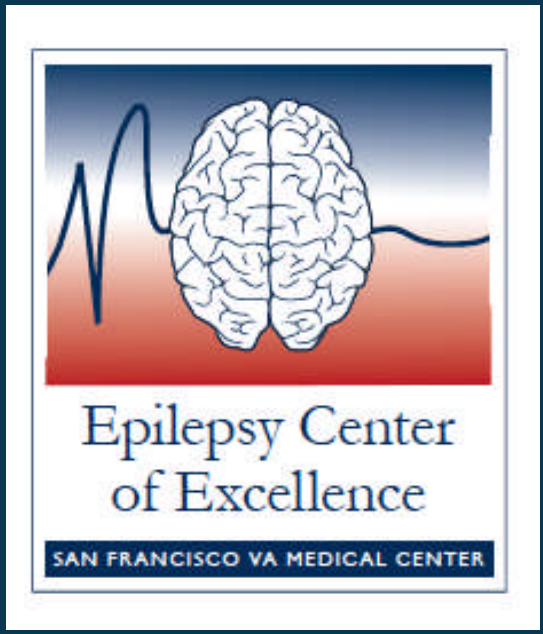

San Francisco VA Epilepsy Center of Excellence:

Epilepsy & Traumatic Brain Injury

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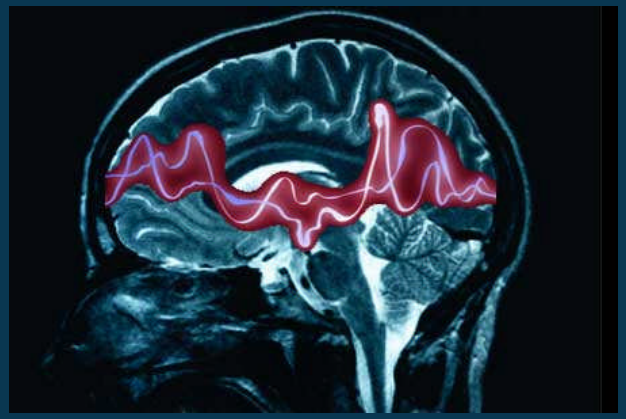
Outline for Day

- 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

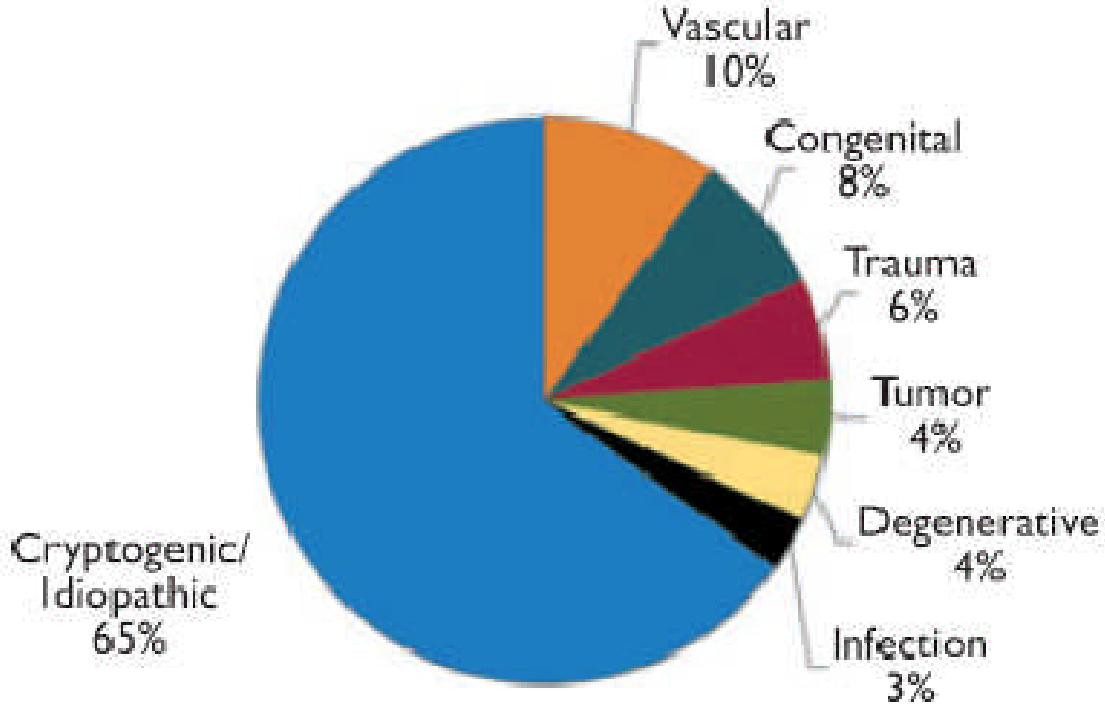


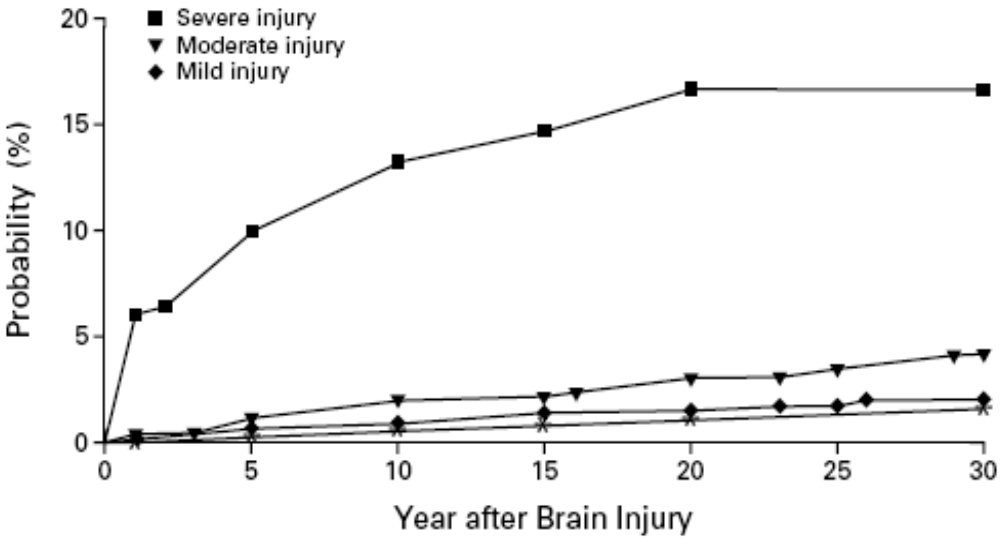
Figure 1.
Proportion of incidence cases of epilepsy by etiology in Rochester, Minnesota, U.S.A., 1935–1984 (Hauser et al., 1993).

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)

POPULATION-BASED STUDY OF SEIZURES AFTER TRAUMATIC BRAIN INJURIES



No. of Patients				
Mild injury	2758	1751	1191	609
Moderate injury	1455	934	660	351
Severe injury	328	181	136	74
Total	4541	2866	1987	1034

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

Representative posttraumatic epilepsy studies

Series	No. of Cases	No. with Fits	Per Cent with Fits
World War I			
Credner	1990	755	38.2
Ascroft	317	107	34.0
World War II			
Russell	820	356	43.0
Walker & Jablon	739	207	28.0
Korea			
Caveness & Liss	407	97	23.8

(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%

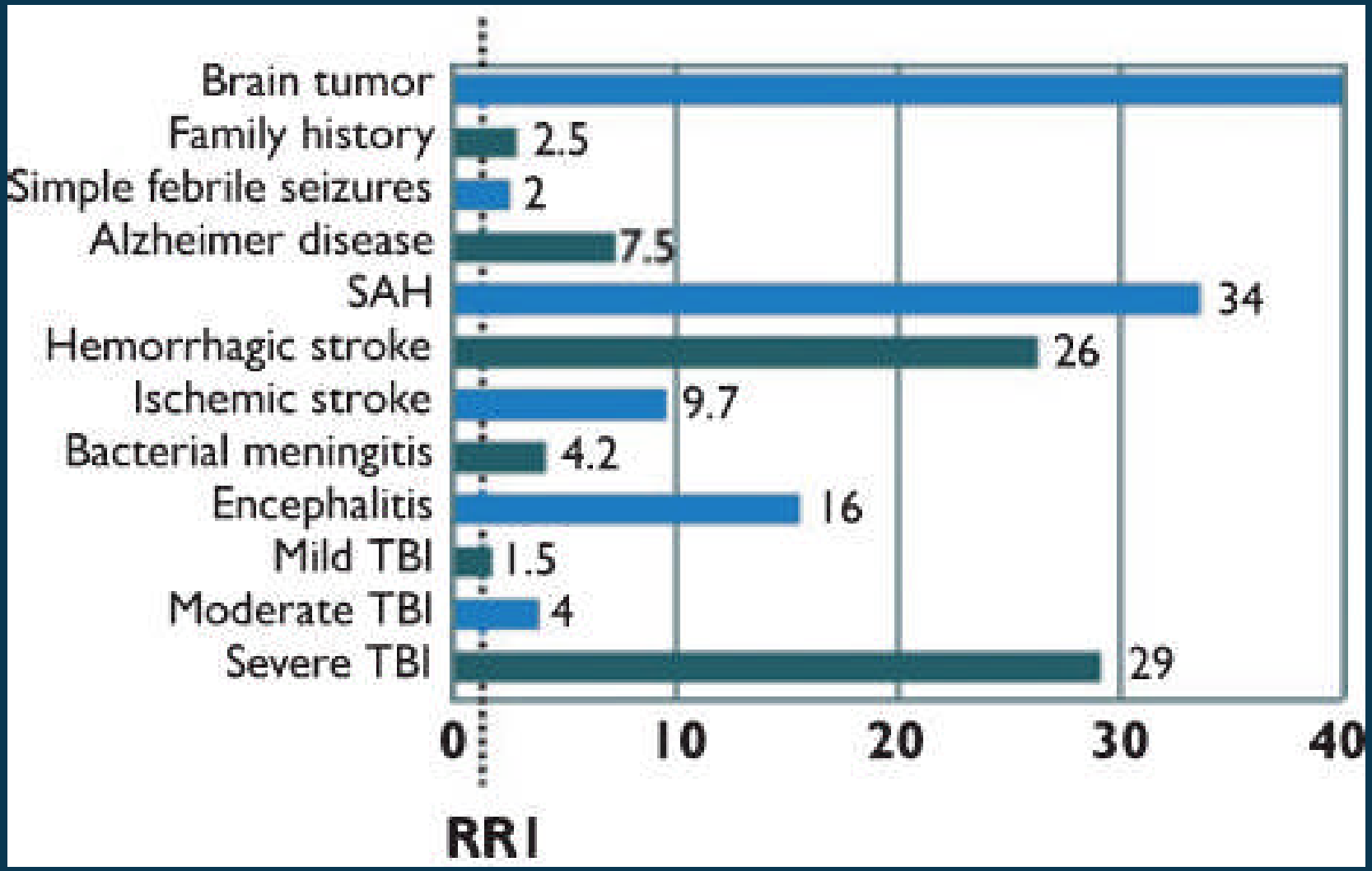
(Salazar *et al.* Neurology 1985; 35: 1406)

Lessons from Conflicts

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

(Salazar 1985)

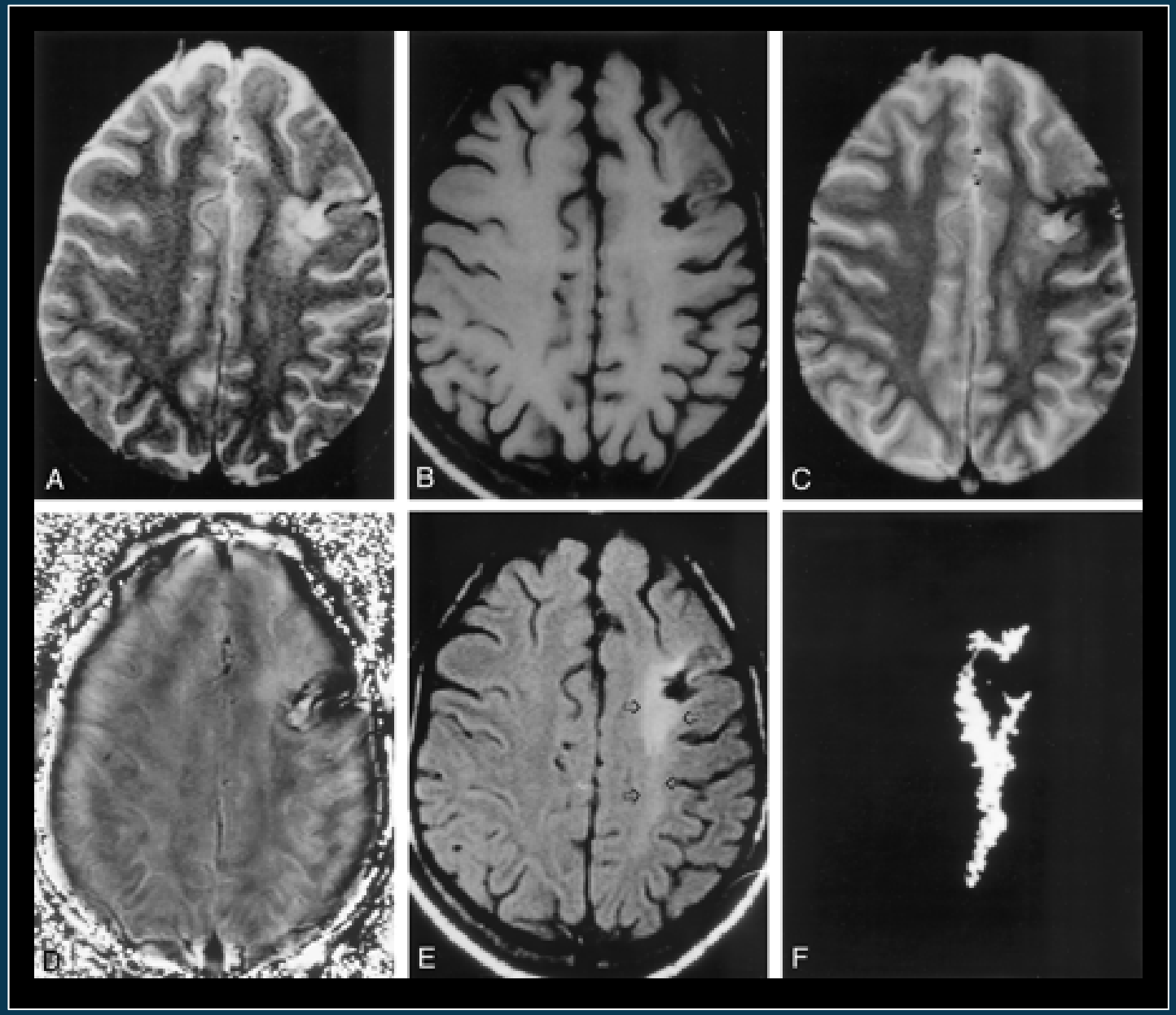
Relative risks for developing epilepsy



(Herman 2002)

TBI Risk Factors for Epilepsy

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



(Kumar 2003)

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

Our Team