TELE-REHABILITAION GUIDELINES

Management of Seizures in the Patient with -Traumatic Brain Injury

Author(s):	Rani Lindberg, MD	Peer Reviewed:		Finalized:	
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I. Definition, Assessment, Diagnosis
  A. Definition:
    1. A seizure is the transient onset of paroxysmal events resulting from abnormal electrical activity within the brain due to excessive or synchronous neuronal activity (Fisher, 2014; Falco-Walter, 2018).
    2. Traumatic Brain Injury is a common cause of epilepsy and is the leading cause of epilepsy in young adults (Annegers, 1996).
    3. Post-traumatic seizure (PTS) refers to a single or recurrent seizure episode occurring after Traumatic Brain Injury (TBI) (Zasler, 2022, p.2709).
      a. Post-traumatic seizures can be further classified as:
        1) *Immediate* (within 24 hours of injury onset)
        2) *Early* (< 1 week after injury)
        3) *Late* (> 1 week after injury)
        4) Other potential seizure etiologies include: premorbid epilepsy, hypoxia, sepsis, electrolyte disturbances, alcohol withdrawal, medications, brain lesion, etc.
      b. Seizures can occur at any time after TBI. Incidence varies by severity and intracranial pathology with the highest noted in penetrating injuries. Neurosurgical procedure also increases risk of subsequent seizure (Ritter, 2016).
      c. Occurrence amongst hospitalized TBI patients has been estimated to be 5-7% with increased risk for severe TBI (11%) and marked increase (35-50%) for TBI from penetrating head injury (Yablon, 1993).
      d. Risk factors for development of late PTS include ((Zasler, 2022, p.2740-2743).:
        1) Severity of injury
        2) Penetrating head injury
        3) Intracranial hemorrhages (epidural and subdural)
        4) Depressed skull fracture
        5) Adult age
        6) Premorbid alcohol abuse
        7) Family history of PTS
        8) Early PTS
      e. Incidence of new onset seizure is highest in the first year after injury and most (82%) will.

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1) 82% of individuals with late posttraumatic seizures do so within the first 2-years post-injury with an incidence of 8% in patients with mild TBI (GCS 13-15) _and 16.8% in patients with severe TBI (GCS 3-8).

B. Assessment
   1. Patients may exhibit a variety of classically associated seizure symptoms depending on the area of epileptogenesis, such as (Fisher, 2017, Zasler, 2022, 2719-2720):
      a. Convulsions
      b. Muscle rigidity
      c. Repetitive motor activities
      d. Staring spells
      e. Visual disturbances or hallucinations
      f. Auditory disturbances or hallucinations
      g. Changes in mood or affect
      h. Dysesthesias
      i. Electrical sensations
      j. Numbness
   2. Impairments from TBI can mask signs and symptoms of a seizure. Thus, observation for subtle clues and symptoms is essential to diagnosis. Sequelae, such as behavior disorders and depression can cloud the diagnostic picture (Hudak, 2004).
   3. New observations of focal motor, sensory, or communication deficit should raise clinical suspicion for recently unwitnessed Post-Traumatic Seizure (Zasler, 2022, p. 447).

C. Diagnosis
   1. Diagnosis of seizure generally begins with a comprehensive history to help characterize the seizure and identify risk factors and potential seizure etiology. History should include but not be limited to:
      a. Description of seizure activity and surrounding events
      b. Medications
      c. History of seizures and compliance with medications
      d. Drug and alcohol use
      e. History of TBI
      f. History of stroke, intracranial infection, or neurogenerative disease
      g. Family history of seizures
   2. Physical exam should include a comprehensive neurological exam
   3. Laboratory tests and imaging can be helpful in identifying the etiology of seizure.
      a. Laboratory studies can include:
         1) Comprehensive metabolic panel including sodium, glucose, calcium, magnesium, renal and liver function levels
         2) Hematology studies
         3) Toxicology screens
         4) Serum prolactin level (elevated post seizure, must be drawn within 1 hour of the event)

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5) Lumbar puncture is indicated if there is suspicion of a central neurologic infectious process

b. Imaging is indicated during seizure work up to evaluate brain structures (Bernasconi, 2019):
   1) Noncontrast CT Head is the initial recommended imaging modality for emergent evaluation of patients presenting with seizures especially if neurological deficits are present on exam, there are predisposing factors for seizure, or seizure is focal.
   2) Magnetic resonance imaging (MRI) is better able to identify structural causes of seizures such as TBI, brain tumors, vascular malformation, cerebral infarction and/or hemorrhage, some infectious processes, mesial temporal sclerosis, and cortical dysplasia.

4. Definitive diagnosis can be made with an electroencephalogram (EEG).
   a. Confirmation via EEG requires capture of the event to make diagnosis however the absence of findings does not necessarily rule out the possibility of seizures (Binnie & Stefan, 1999).
   b. It may be necessary to refer patients to an epilepsy monitoring unit, where video electroencephalogram (VEEG) can be performed (Cascino, 2002). VEEG utilizes a longer period of observation and recording in attempt to capture events that may be missed on a standard EEG. Admissions for this process can typically span 24-72 hours.
   c. VEEG can help in differentiating true epileptic events from psychogenic non-epileptic seizures (NES). Psychogenic NES can have a similar clinical presentation to epileptic events, making diagnosis otherwise difficult.
5. Postictal prolactin measurement may be helpful to confirm seizure activity in some cases. Generalized tonic clonic and complex partial seizures can cause significant elevations in serum prolactin 20-40 minutes following a seizure episode. It is recommended that a baseline prolactin level be drawn within a few days of the seizure event around the same time of day as the seizure event as prolactin levels vary throughout the day.(Zasler, 2022, p. 2751,).

II. Management and Treatment Recommendations
   A. Immediate management should consist of measures to protect the patient from injury during the immediate seizure and postictal state (Schafer, 2014):
      1. Placing the patient in a safe position from which they cannot fall. Remove any hazards, such as sharp objects from the immediate area.
      2. Position patient on his or her side to help protect the airway if he or she is unconscious.
      3. Record the time of onset and length of seizure.
      4. Do NOT attempt to place anything in the mouth of the unconscious patient, including medications.
      5. Do NOT attempt to hold the patient down if they exhibit convulsions.

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6. Remain with the person until the seizure has ended. This may span a few seconds or several minutes.
7. If concern exists for the patient's breathing status or an injury is suspected, immediately call emergency medical services.

B. A patient that is in status epilepticus requires immediate emergency medical treatment. Status epilepticus be defined as a continuous, generalized, convulsive seizure lasting >5 min, or two or more seizures between which the patient does not return to baseline consciousness (Lowenstein, 1998).

C. Referral to a neurologist for further workup and appropriate selection of anti-epileptic drugs (AEDs) is recommended.

D. For a patient who has recalcitrant, late PTS, evaluation for surgical resection of the epileptic foci may be necessary for treatment.

E. The state of Arkansas does not currently require that physicians report epilepsy to the state Office of Driver Services; the onus to do so resides with the patient. The Office of Driver Services may impose restrictions to ensure the safe operation of the motor vehicle. A patient must be seizure-free for 12 months and pass a medical evaluation by a state-licensed physician that is reviewed and approved by the Office of Driver Services for reinstatement of driving privileges ("State driving laws database").

III. Prevention and Education

A. Anti-epileptic Drugs (AEDs) for treatment and prevention of PTS have been evaluated to varying degrees by randomized controlled trial. Currently, prophylactic treatment of PTS is not routinely recommended beyond one week following head injury (Lowenstein, 2000; Fordington, 2020).

1. Prior to initiating treatment, please consider the following: drug effectiveness for seizure type, possible adverse effects including neurological/cognitive impairments, medication interaction, cost, patient age and pregnancy risk.
2. Phenytoin is the most rigorously tested AED for PTS
    a. Phenytoin is useful for prophylactic treatment of Early Post- Traumatic Seizures (those that occur during the first week following injury).
    b. There is no protective effect after the early PTS time period thus there is NO support for using phenytoin in the prevention of Late Post- Traumatic Seizures. (Temkin, 1990).
    c. It is important to recognize that phenytoin displays significant drug-drug interactions, has a robust side-effect profile, and requires monitoring of serum drug levels, which must be taken into account when choosing this medication.
3. Carbamazepine also demonstrates improvement in Early PTS prophylaxis but not in Late PTS prophylaxis (Glotzner, 1983).
    a. Carbamazepine requires monitoring of serum drug levels and has a large interaction profile with other medications.

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2. Levetiracetam is a newer generation of AED that has several advantages over the older generation, including decreased drug interaction and side-effect profile. It requires no loading dose or typical serum monitoring. (Jones et al., 2008).
3. Immediate seizures (within 24 hours post TBI) do not require any additional treatment prophylaxis and treatment after 7 days. Early and Late PTS should be treated for at least 24 months unless a causal time-limited intracranial abnormality is present and addressed (hydrocephalus, active hemorrhage, infectious process) (Fordington, 2020).

This guideline was developed to improve health care access in Arkansas and to aid health care providers in making decisions about appropriate patient care. The needs of the individual patient, resources available, and limitations unique to the institution or type of practice may warrant variations.

Guideline Developers
Guideline developed by Rani Lindberg, MD, in collaboration with the TRIUMPH Team led by Medical Director Thomas S. Kiser, MD, and Rani Haley Lindberg, MD.

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