Seizures are a fairly common medical emergency, accounting for about 4% of all EMS calls. Most are brief and self-limited, typically stopping on their own in less than two minutes, and they present a low risk of harm for the patient. In contrast, status epilepticus (i.e., prolonged seizures) are a true neurological emergency. Between 120,000 and 200,000 patients suffer from status epilepticus in the U.S. annually, contributing to 55,000 deaths each year. Status epilepticus has other potentially severe consequences including hypoxia, metabolic acidosis, hyperthermia, aspiration, pulmonary edema and brain injury, and may lead to additional seizures in the future. Acute recognition and aggressive treatment of seizures and related complications is the foundation of pre-hospital care.

One in 10 Americans will suffer at least one seizure in their lifetime. For most, this is an isolated event related to an underlying illness or injury, such as a fever, head injury or alcohol withdrawal. Epilepsy, which is less common than seizures, is defined as recurrent unprovoked seizures due to a primary brain disorder.

**Types of Seizures**

Seizures are generally categorized as one of the two types: generalized and partial. Generalized seizures affect the entire brain and, as a result, are associated with an altered level of consciousness. A post-ictal period of confusion with gradual return to baseline is common. In contrast, partial seizures affect only a portion of the brain, and alertness may be maintained. A post-ictal period is rare in partial seizures.

Tonic-clonic seizures are the classic generalized seizures characterized by loss of consciousness and full-body rigidity (tonic phase) and rhythmic convulsions (clonic...
Because of the loss of muscular tone, airway compromise and respiratory depression may occur.

Other generalized seizures include absence seizures, previously known as petit mal seizures, during which the patient stares and stops responding appropriately. Generally, the patient has no motor activity, but a post-ictal period still occurs. Less commonly encountered generalized seizures include tonic, which are rigid without convulsions, and atonic, which is characterized by a complete and sudden loss of muscle tone.

In simple partial seizures, the convulsions are limited to one area of the body, or patients may experience unusual feelings or sensations. In complex partial seizures, the patient’s consciousness is impaired. It’s important to note that partial seizures may progress to involve the entire brain. In this case, they’re termed partial seizures with secondary generalization.

**Status Epilepticus**

Status epilepticus refers to seizures/convulsions that don’t terminate within five minutes or repeat seizures without an interval return to baseline mentation. Status epilepticus is a true emergency with increasing morbidity and mortality based on the duration of convulsions. The risk of death within a month of suffering status epilepticus is more than 20%.

Status epilepticus is an emergent condition and early, aggressive treatment is critical to successful seizure termination and better patient outcomes. Status epilepticus seizures that continue without treatment are much harder to control and require much higher doses of benzodiazepines than those that are treated early. Early status epilepticus termination is also associated with improved outcomes and reduction of complications. In contrast, simple seizures are self limited and usually require supportive care only.

The classic definition of status epilepticus used to be seizures lasting at least 30 minutes. The shift from 30 minutes to five minutes or less without a return to baseline mentation was prompted by several factors, including the observation that seizures lasting more than five minutes are unlikely to terminate spontaneously, and prolonged seizures cause
cardiovascular instabilities and direct neuronal injury. Based on accepted pre-hospital
time intervals, more patients should be considered to be in status epilepticus than in the
past. This includes any patient who was seizing at the time of the 9-1-1 call and who was
still seizing at EMS arrival, or begins seizing again without return to baseline.

**Differential Diagnosis**

EMS providers should keep in mind that seizures are often signs/symptoms of
underlying disease and should actively consider why the patient is seizing. Hypoglycemia
should be ruled out in every seizing patient. However, other metabolic derangements,
including hyponatremia, hypernatremia and hypocalcemia, can also induce seizures.
Although fevers can provoke seizures, many infectious diseases are associated with
seizures even in absence of fever. Viral, bacterial and fungal meningitis, encephalitis,
cerebral abscess and malaria can all present with seizure activity.

Many medications can also cause seizures, even when taken in normal doses.
Antimicrobials, cardiovascular medications, sympathomimetics (including illicit drugs),
and even anti-epileptic medications can cause seizures. Overdoses of aspirin, lithium,
isoniazid and anticholinergics, such as tricyclic antidepressants and antihistamines, can
cause fatal and difficult-to-control convulsions. Withdrawal from alcohol,
benzodiazepines, and sedative-hypnotic medications can also cause seizures. Such
seizures often occur when chronic users suddenly reduce or stop using these agents.
EMS providers should also consider traumatic and non-traumatic intracranial injury or
lesions. Subdural and epidural hematomas, subarachnoid hemorrhage, cerebral
contusions, intracranial hemorrhage and brain cancer can all be associated with
seizures.

The relationship between ischemic stroke and seizure deserves special mention. Some
patients will exhibit temporary focal neurologic deficits following a seizure, a condition
called Todd’s Paralysis. This patient may be identified as a stroke patient. Todd’s
paralysis is considered to be a stroke mimic. Ischemic stroke can cause generalized
convulsions because of metabolic derangements in the central nervous system. Patients
presenting with neurological deficits following a seizure should be treated as acute stroke patients until proven otherwise.

**Seizure Mimics and Non-Epileptic Convulsions**

Abnormal motor movements and altered mentation are often misinterpreted as seizures. This may lead to inaccurate dispatch information. Syncope or cardiac arrest can cause occasional myoclonic jerks, where the patient’s arms or legs will twitch or jerk. These aren’t rhythmic or sustained. And in the case of syncope, there’s no post-ictal period. At times, the confused state of a patient with hypoglycemia can mimic the post-ictal period. A non-epileptic convulsion, which is the proper term for “pseudoseizures” or “psychogenic seizures,” is difficult to distinguish from true seizures. This is especially true in the pre-hospital setting, where providers don’t have the necessary diagnostic equipment. To complicate matters, many patients with true seizures will also have non-epileptic spells. In the field, a decision to withhold treatment on the assumption that the exhibited activity is non-epileptic can be dangerous and is not appropriate.

**Pre-hospital Seizure Care**

Preceding signs and symptoms of illness may identify the trigger for the seizure. For example, fever may indicate infection, vomiting may have prevented the patient from taking their maintenance antiepileptic drugs. New medications may also precipitate seizures. Because the prevalence of seizures without epilepsy is so high, don’t rely on a previous diagnosis to confirm that a seizure occurred.

Note the time of onset of convulsions, as well as the length of post-ictal phases. Most seizures will stop spontaneously within a few minutes and don’t require immediate action. However, if status epilepticus is suspected, then prompt treatment is necessary to minimize morbidity and mortality.
Assessment

Remember the importance of Airway, breathing and circulation: Without a doubt, the “ABCs” are as important to the seizing patient as they are for any emergency condition. However, EMS providers must recognize that abnormal ABCs are likely the result of, rather than the cause of, the seizures. Rapid medication administration should take priority over airway control (as long as the airway is patent) and other procedures.

Managing the airway of an actively seizing patient can be daunting. The patient’s tongue, mucous or vomitus may occlude the airway. Performing a head-tilt/chin-lift, use of an oral airway and oral suctioning may be difficult because of a patient’s clenched jaw and tonic-clonic movements. Use of a nasopharyngeal airway and supplemental oxygen via non-rebreather mask may be easier to accomplish. Pulse oximetry may be difficult to apply or maintain because of patient movement, but it should be attempted.

Capnography may be useful both for assessing the patient’s respiratory status during the seizure and for carefully monitoring a patient treated with benzodiazepines for respiratory depression. Vital signs, including blood pressure, should be monitored. Blood glucose should be evaluated in all seizing patients to rule out hypoglycemia. ECG monitoring should be established, as cardiac dysrhythmias and sudden death can occur. Although important, these assessments and interventions should not distract the provider from rapidly administering anti-convulsant medications when indicated.

Secondary Survey

The secondary survey should focus on finding clues related to the cause of the seizure (e.g., trauma), complications of the seizure (e.g., tongue laceration), or subtle clues that the seizure may be continuing. Identification of a medical alert tag will certainly provide useful information.

Unequal pupils and Cushing’s Triad (hypertension, bradycardia, and abnormal respirations) may suggest increased intracranial pressure due to, for example, intracranial hemorrhage (ICH) and resulting cerebral herniation. A forced gaze deviation can be associated with ischemic stroke or ICH.
At times, the only motor activity that can occur in the presence of ongoing seizure activity in the brain is a beating nystagmus, which is often associated with gaze deviation.

Prolonged seizures may evolve into subtle neurologic findings, and it can be difficult to definitively determine whether a seizure has ceased and the patient has entered the post-ictal phase. In more than 10% of status epilepticus patients, convulsions cease or show only subtle symptoms, notwithstanding continued electrical seizure activity. In the emergency department (ED), physicians are often challenged to distinguish ongoing non-convulsive status epilepticus from the post-ictal phase.

Pre-hospital providers must be alert for subtle, ongoing status epilepticus that requires further pharmacological intervention.

Any continuing convulsions or jaw, lip, finger or eyelid twitching, even minor, should be considered ongoing seizure activity because ocular deviation or nystagmus—rapid, involuntary movement or twitching of the eyes—also reflects ongoing electrical seizure activity. Aggressive treatment is just as important for patients with subtle status epilepticus as it is for those with obvious convulsions.

**EMS Treatment**

Seizing patients should be placed in a safe position—the floor with nearby furniture and objects moved away. This will minimize the risk of secondary trauma. Avoid any attempts to restrain the patient because doing so may result in injury to the patient or provider. Do not place objects (e.g., oropharyngeal airway) into the patient’s mouth. Supplemental oxygen, suctioning and nasopharyngeal airways can be considered. Establishing IV access may be useful, but all of these secondary treatments should be considered only after the seizure has stopped or the first dose of benzodiazepines has been given.
Pharmacological Intervention

Effective termination of a seizure requires early administration of benzodiazepines. Diazepam, lorazepam and midazolam have individual pros and cons, but they all play a role in achieving seizure cessation. As the EMS drug shortages continue, EMS agencies should be familiar with all three of these medications in the event that one or more of them isn’t available. Diazepam is most often given via the patient’s rectum or via IV. Rectal suppositories are available for home use. Although they’re most often used in small children, some adults may have been treated in this manner prior to EMS arrival. Lorazepam, which is usually given via IV, can be a difficult medication to maintain in the EMS setting because it degrades when kept at room temperature and must be discarded after 60 days if not refrigerated. The amount of degradation over time is related to temperature exposure, which may affect the length of drug rotation and deployment. Midazolam is rapidly and reliably absorbed after intramuscular (IM) injection and can be given intranasal (IN) or via IV as well, although the IN route hasn’t been thoroughly evaluated in adults. Midazolam doesn’t require refrigeration and maintains its potency over time better than lorazepam. Because of its pharmacologic properties and demonstrated efficacy, IM midazolam is an effective first-line treatment for pre-hospital status epilepticus.

Several studies have compared benzodiazepines to identify which one may be best for EMS use. In one study, lorazepam via IV and diazepam via IV fared similar and both did better than the placebo. In a meta-analysis, IM or IN midazolam was shown to be more effective than IV diazepam in children and adolescents; and in another, IM midazolam did better than IV lorazepam.

The only bad choice in the treatment of a patient in status epilepticus is not aggressively giving benzodiazepines at adequate doses because of fear of causing harm. Untreated patients are twice as likely to require airway support, and respiratory depression requiring intervention is relatively uncommon in treated patients. Although the first dose of a benzodiazepine will control most status epilepticus if it’s given early enough and in appropriate doses, many patients may require repeat doses. The risk of
respiratory depression may increase with additional benzodiazepine doses, but these risks are far less than the harm that may result from allowing the patient to continue seizing.

**Complications of Status Epilepticus**

When early benzodiazepine therapy doesn’t terminate the seizure, providers must be prepared to manage various serious complications, including hyperthermia, tachycardia, systemic and pulmonary hypertension, pulmonary edema, cardiac arrhythmias, metabolic acidosis, hypoxia, hyperkalemia and hyperglycemia.

**Post-ictal State**

Following a seizure, most patients will enter a post-ictal phase, during which they may be in a deep sleep or exhibit confusion, combativeness, poor short-term memory or irritability. One sign that a patient has entered the post-ictal phase—other than the cessation of convulsions—is a return of a normal ventilatory pattern and pupillary activity. This is in contrast to during a seizure, when the patient’s eyes will often be diverted, will not respond normally to light and may be abnormally constricted or dilated.

The post-ictal patient’s level of consciousness should slowly improve, returning to normal within 30 minutes. If a patient remains unconscious (not merely asleep) after 30 minutes, then continuing seizure activity or another serious underlying central nervous system disturbance (e.g., significant head trauma) should be suspected.

A prolonged seizure may ultimately result in complete electromechanical disassociation, in which all convulsions have ceased but electrical seizure activity continues in the brain. This condition is called non-convulsive status epilepticus (NSE), and diagnosis requires electroencephalogram (EEG) monitoring. It is impossible to differentiate NSE from other causes of coma in the field. In the absence of any physical manifestation of seizure other than unconsciousness, it’s important to consult medical control before continuing pharmacological treatment. The post-ictal patient generally requires supportive care
only, although this can include aggressive suctioning and airway management. An IV should be established to allow for further treatment if required. Repeated airway and cardiac assessments using such tools as capnography are essential.

**Pediatric Status Epilepticus**

A large percentage of the patients experiencing status epilepticus are children. Seizures are the most common reason for EMS transport of children. Working with pediatric patients exacerbates the challenges that seizing patients present. For example, establishing IV access in young children can be difficult and drug dosage calculations can leave room for error. Parents of a child with epilepsy usually are familiar with their child’s seizure and medication history and response to pre-hospital treatments. Parents should be included as part of the pre-hospital care team. This will result in better care and the parents will have a much higher sense of satisfaction.

Although seizures in adults may follow predictable patterns, the presentation in children may change dramatically over time. Be alert for repetitive or prolonged seizures even in children who haven’t had that history previously. Incorrectly concluding that a child is post-ictal can have severe negative consequences if they continue to seize during transport to the hospital despite the cessation of convulsions.

EMS providers should consider treatments that don’t require IV access, especially for younger children. Diazepam rectal suppositories (Diastat) are available as a home rescue medication. This medication comes in a pre-measured, pre-filled syringe containing diazepam gel designed to be used by parents, teachers and others without formal medical training. Dosages range from 5–20 mg and are based on the child’s weight. Paramedics administering benzodiazepines need to determine whether medications have been administered prior to their arrival. EMS providers should be prepared to administer additional doses of benzodiazepines if patients continue to seize.

The rectal route has benefits in comparison to IV medications, especially in situations in which obtaining vascular access is challenging or the time required is unacceptably long.
However, absorption can be erratic and public/social factors may delay administration until the child’s privacy can be protected. Given these limitations, IN and IM midazolam are attractive alternatives to rectal diazepam. The IN route has been well studied in children and adolescents. Studies conclude that midazolam is rapidly absorbed via the nasal mucosa, and IN midazolam is as effective as IV diazepam in controlling seizures. Compared to rectal diazepam, IN midazolam has a more consistent and higher bioavailability with a short time to peak concentration.

Midazolam is available in 1 mg/mL and 5 mg/mL concentrations. Given that a maximum of 0.5–1 mL should be administered per nostril, the higher concentration will be needed for all patients except the youngest children if the IN route is chosen. To be effective, the medication must be atomized when administered intranasally.

**Conclusion**

Pre-hospital providers must focus on identifying and treating status epilepticus early via effective pharmacological treatment. Early, aggressive treatment has significant benefits, including a higher likelihood of successful seizure termination. Early termination simplifies airway management and reduces the risk of hypoxia and other severe complications. Because researchers have reflected on the importance of early, effective care, the definition of status epilepticus has been shortened to five minutes. Given that pre-hospital providers rarely arrive on scene in less than five minutes, a patient still seizing at the time of EMS arrival should be considered to be in status epilepticus and treated without delay.

**Key Terms**

**Seizure:** A hyperexcitation of neurons in the brain that can result in involuntary motor activity, sensory disturbances, abnormal behavior, loss of consciousness or all of these.

**Epilepsy:** A group of neurologic disorders characterized by recurrent unprovoked seizures

**Generalized seizures:** Seizures that affect the entire brain, and, as a result, are
associated with an altered level of consciousness. A post-ictal period of confusion with gradual return to baseline is common

**Partial seizure:** A seizure that affects only a portion of the brain; alertness can be maintained

**Tonic-clonic seizure:** The classic generalized seizure characterized by loss of consciousness and full-body rigidity (tonic phase) and rhythmic convulsions

**Absence seizures:** The seizure seen in absence epilepsy, consisting of a sudden momentary break in consciousness of thought or activity, often accompanied by automatisms or clonic movements, especially of the eyelids

**Simple partial seizure:** The most localized type of partial seizure, with a discharge that is predominantly limited to one area of the body, or patients may experience unusual feelings or sensations

**Complex partial seizure:** A type of partial seizure associated with varying degrees of impairment of consciousness

**Status epilepticus:** A medical emergency characterized by continuous seizures lasting more than five minutes or recurrent seizures without a return to baseline in between episodes
Seizure

Note:

- Seizures usually last from 1-3 minutes and involve a loss of consciousness and convulsions. Not uncommonly, the patient is incontinent and may bite his tongue or be injured in other ways.
- When the seizure is over, the patient enters a postictal state, characterized by confusion eventually giving way to normal alertness and orientation.
- Whenever seizures occur, look for an underlying cause and treat it. If the patient is more than 20 weeks pregnant, refer also to the Eclampsia Protocol.
- Status epilepticus is defined as a seizure lasting longer than 5 minutes, or frequently recurring seizures without clearing of the postictal state between seizures. This is a life-threatening emergency!

**EMERGENCY MEDICAL RESPONDER (EMR) / EMERGENCY MEDICAL TECHNICIAN (EMT)/ ADVANCED EMT (AEMT)/ INTERMEDIATE / PARAMEDIC**

1. Perform primary medical assessment and Initial Medical Care
3. Protect the patient from injury. Do not place anything in their mouth if seizing (Nasopharyngeal airway recommended.)
4. Position patient on their side unless contraindicated (recovery position).
5. Titrate supplemental oxygen to lowest level to maintain pulse ox greater than 93%¹ (if severe underlying lung disease goal is 88-92%). Do not withhold oxygen if you do not have the ability to assess O2 saturations.
6. Note and report the following:
   * Any apparent cause of seizure
   * History of seizures
   * Medications: amount and time of last dose
   * Focus of seizure origin: one limb or whole body
   * Eye deviation prior to or during seizure
   * Trauma to oral cavity
   * Incontinence
7. Observe patient's sensorium and airway status during postictal period.
   Time the duration of confusion during the postictal period.

**EMERGENCY MEDICAL RESPONDER (EMR) / EMERGENCY MEDICAL TECHNICIAN (EMT)**

If trained to obtain blood glucose and glucometer available, obtain blood glucose. If less than 60, go to Hypoglycemia Protocol.

**ADVANCED EMT (AEMT)/ INTERMEDIATE / PARAMEDIC**

8. Obtain blood glucose. If less than 60, go to Hypoglycemia Protocol.

¹ Cyanotic Heart Disease pulse ox goal 75-85%
INTERMEDIATE / PARAMEDIC

1. Attempt to time duration of seizure activity. If generalized tonic-clonic seizure lasting greater than 2 minutes or recurrent seizures: (and not Hypoglycemic)
   If no IV access in place give:
   Versed 10 mg IN/IM in adults or Versed 5 mg IN/IM in Peds (13 to 40 kg), Peds less than 13 kg give Versed 0.2 mg/kg IN/IM. May repeat in 10 minutes if seizures continue.
   If IV access already in place give:
   Versed 5-10 mg (Peds 0.1mg/kg, max 10 mg/dose) IV/IO. May repeat every 3-5 min if seizures continue
   Or Ativan 2-4 mg IV/IO or 4 mg IM (Peds 0.1 mg/kg IV/IO/IM, max 4 mg/dose). May repeat every 3-5 min IV/IO if seizures continue
   Or Diazepam 5-10 mg slow IV/IO (Peds 0.1 mg/kg IV/IO). May repeat every 3-5 min if seizures continue
   • Side effects may include hypotension and respiratory depression.
   • Monitor Airway and document vital signs at least every 5 minutes, to include: blood pressure, pulse, respirations, pulse oximetry and End tidal CO2 if available.

ADVANCED EMT (AEMT)/ INTERMEDIATE / PARAMEDIC

2. Establish IV/IO** if still seizing, not awakening or other concerns.

PARAMEDIC

3. If ambulance out of benzodiazepines and patient still seizing, give Ketamine 1-2 mg/kg IV/IO or 4-5 mg/kg IM

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1 UNDER WI SCOPE OF PRACTICE- INTERMEDIATE SQUADS MAY CHOOSE ONLY ONE SEIZURE MEDICATION. VERSED IS THE PREFERRED MEDICATION.

** IO is an additional skill at the AEMT level requiring additional training approved by the Medical Director and State Approval.