Neurologic Emergencies

Patients may present with one of several non-traumatic neurological emergencies. We will discuss the most common of these in this CE. Your primary treatment of any neurologic emergencies will supportive and aimed at decreasing symptoms, since most cannot be “cured” in the field.

Stroke
Stroke is a general term that describes injury or death of brain tissue usually due to interruption of cerebral blood flow. The term “brain attack” is used because it compares the physiology of a stroke with that of a heart attack. In both cases, oxygen deprivation causes damage to the affected tissue.

Classifications of Strokes
The American Heart Association has defined two primary categories of stroke: ischemic stroke and hemorrhagic stroke.

Ischemic Stroke
Approximately 85% of strokes are the ischemic type. An ischemic (or occlusive) stroke occurs when a cerebral artery is blocked by a clot or other foreign matter. This results in ischemia and progresses to infarction, the death of tissues as a result of cessation of blood supply. These strokes are further classified as either thrombotic, embolic, or a result of systemic hypoperfusion.

Thrombotic stroke: A cerebral thrombus is a blood clot that gradually develops in and obstructs a cerebral artery. As a person ages, plaque deposits can form on the inner walls of arteries. The buildup causes a narrowing of the arteries and reduces the amount of blood that can flow through them. This process is known as atherosclerosis. Once the arteries are narrowed, platelets adhere to the roughened surface and can create a blood clot that blocks the blood flow through the cerebral artery. This results in brain tissue death. The signs and symptoms of thrombotic stroke develop gradually. This type of stroke often occurs at night with the patient awakening with altered mental status and /or loss of speech, sensory or motor function.

Embolic stroke: A stroke caused by an embolus results when an intracranial vessel is blocked by a foreign substance. This can be a solid, liquid or gaseous material carried to a blood vessel from a remote site. Common sources of cerebral emboli include:
⇒ Atherosclerotic plaques originating from large vessels of the head, neck or heart
⇒ Thrombi that develop on the valves or in the chambers of the heart
⇒ Air embolism from chest injuries
⇒ Fat embolism from long bone injuries

Signs and symptoms of cerebral embolus are similar to those of thrombotic. However, embolic signs and symptoms develop more quickly. Also, they often are associated with an identifiable cause (e.g. atrial fib).

Systemic hypoperfusion: Systemic hypoperfusion is a more general circulatory problem, manifesting itself in the brain and perhaps other organs. Reduced perfusion can be due to cardiac pump failure caused by cardiac arrest or arrhythmia, or to reduced cardiac output related to acute myocardial ischemia, pulmonary embolism, pericardial effusion, or bleeding. Hypoxia may further reduce the amount of oxygen carried to the brain. Symptoms of brain dysfunction typically are diffuse and non-focal in contrast to the other two categories of ischemic stroke. Most affected patients have other evidence of circulatory compromise and hypotension.

Hemorrhagic stroke
Hemorrhagic strokes account for approximately 15% of all strokes. They are usually classified as being intracerebral (within the brain) or subarachnoid (the space around the outer surface of the brain).

Intracerebral hemorrhage: Bleeding in intracerebral hemorrhage (ICH) is usually derived from arterioles or small arteries. The bleeding is directly into the brain, forming a localized hematoma which spreads along white matter pathways. Accumulation of blood occurs over minutes or hours; the hematoma gradually enlarges by adding blood at its periphery like a snowball rolling downhill. The most common causes are hypertension, trauma, vascular malformations and illicit drug use. Less frequent causes include bleeding into tumors, aneurismal rupture and vasculitis. An intracerebral hemorrhage begins abruptly. In about half of the people, it begins with a severe headache, often during activity. However, in older people, the headache may be mild or absent. Symptoms suggesting brain dysfunction develop and steadily worsen as the hemorrhage expands. Some symptoms, such as weakness, paralysis, loss of sensation, and numbness, often affect only one side of the body. People may be unable to speak or become confused. Vision may be impaired or lost. The eyes may point in different directions or become paralyzed. The pupils may become abnormally large or small. Nausea, vomiting, seizures, and loss of consciousness are common and may occur within seconds to minutes.
Subarachnoid hemorrhage: Rupture of arterial aneurysms is the major cause of subarachnoid hemorrhage (SAH). Aneurysm rupture releases blood directly into the cerebrospinal fluid (CSF) under arterial pressure. The blood spreads quickly within the CSF, rapidly increasing intracranial pressure. Death or deep coma ensues if the bleeding continues. The bleeding usually lasts only a few seconds but rebleeding is common. With causes of SAH other than aneurysm rupture, the bleeding is less abrupt and may continue over a long period of time. Symptoms of SAH begin abruptly, occurring at night in 30 percent of the cases. The primary symptom is sudden severe headache (97% of cases) classically described as the “worst headache of my life.” The headache is lateralized in 30% of patient, predominantly to the side of the aneurysm. The onset of the headache may or may not be associated with a brief loss of consciousness, seizure, nausea, vomiting, focal neurologic deficit, or stiff neck. There are usually not important focal neurologic signs at presentation unless bleeding occurs into the brain and CSF at the same time.

Assessment

In addition to your normal assessment, all suspected stroke patients should have a Cincinnati Stroke Scale done.

The Cincinnati Stroke Scale is a tool used to identify stroke patients based on 3 physical findings:

<table>
<thead>
<tr>
<th>Test</th>
<th>Findings</th>
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</table>
| Facial Droop: Have patient show teeth or smile | Normal – both sides of face move equally  
Abnormal – one side of face does not move as well as the other side |
| Arm Drift: Patient closes eyes and extends both arms straight out, with palms up for 10 seconds | Normal – both arms move the same  
Abnormal – one arm does not move or one arm drifts down compared with the other |
| Abnormal Speech: Have the patient repeat a phrase that you say | Normal – patient uses correct words with no slurring  
Abnormal – patient slurs words, uses the wrong words, or is unable to speak |
If any one of these 3 signs is abnormal, the probability of a stroke is 72%. The presence of all 3 findings indicates the probability of stroke is greater than 85%.

The other thing that you always want to assess on a suspected stroke patient is their blood sugar. Early hypoglycemic patients can present with focal neurological findings that mimic a stroke. In addition, severe and prolonged hypoglycemia can lead to brain injury, so prompt identification and correction of hypoglycemia is imperative.

Document and inform the hospital of the time the patient’s symptoms started. This is very important in determining if the patient can receive fibrinolytics to break up a suspected ischemic stroke.

Management
Because the outcome of some stroke treatments is time dependent, it is important to rapidly identify and transport any suspected stroke patient. The hospital should be notified immediately of a suspected stroke patient and scene time should be kept at a minimum, ideally less than 10 minutes.

Transport position: The primary aim of acute stroke treatment is to restore blood flow to poorly oxygenated brain tissue. Positioning the head at zero degrees or supine, during assessment and transport may increase arterial blood flow through the effects of gravity. Traditional positioning for most acute neurological conditions has been with 30 degree of head elevation to decrease intracranial pressure. However, in ischemic stroke patients, ICP does not peak until 48 hours post-infarction, and increased blood flow may be more beneficial in the acute setting. However, proper assessment and management of airway, breathing and circulation are of primary importance in acute stroke. Stroke patients may need stabilization of airway and transportation with aspiration precautions. Therefore, they should be transported with the head of their bed elevated 10 - 15 degrees.
To help prevent an increase in intracranial pressure head and neck should be kept in neutral alignment. Do not use pillows.

Oxygen: Decreases in oxygen saturation can lead to worsening of cerebral ischemia. Current recommendations in literature are to monitor oxygen saturation continuously with a pulse oximeter and treat hypoxia with supplemental oxygen. Because there is no conclusive evidence that supplemental oxygen for those that are not hypoxic causes harm, pre-hospital providers may consider the use of oxygen in stroke for patients who are not hypoxic. However, because the goal of treatment should be to maintain normoxia, supplemental oxygen for those who are not hypoxic should be given at low flow rates, titrating pulse ox to no higher than 99%. DAI including Lidocaine 1.5mg/kg should be considered for a GCS 8 or less. Remember Lidocaine needs to be given at least 2 minutes prior to intubation.

IV Access: Since acute stroke should be treated as a time-dependent emergency, rapid transport to a definitive care facility is of utmost importance. Delays in the pre-hospital setting need to be avoided. One potential time delay relates to the establishment of IV access. A field line may be appropriate when acute resuscitation meds need to be give (e.g. DAI, seizures). Otherwise, transportation should be started immediately and IV access secured en route.
Seizures

Normal brain function requires an orderly, organized, coordinated discharge of electrical impulses. Electrical impulses enable the brain to communicate with the spinal cord, nerves, and muscles as well as within itself. A seizure is a temporary alteration in behavior due to the massive electrical discharge of one or more groups of neurons in the brain. This abnormal paroxysmal activity is intermittent and usually self-limited, lasting seconds to a few minutes.

Seizures are divided into 2 basic categories:

Epileptic: These seizures have no apparent cause (or trigger) and occur repeatedly. These seizures are called a “seizure disorder” or “epilepsy.”

Nonepileptic: These seizures are triggered (provoked) by a disorder or another condition that irritates the brain. In children, a fever can trigger a nonepileptic seizure.

Certain mental disorders can cause symptoms that resemble seizures, called psychogenic nonepileptic seizures.

About 2% of adults have a seizure at some time during their life. Two thirds of these people never have another one. Most commonly, seizure disorders begin in early childhood or in late adulthood.

Causes

Most common causes by age group:

Before age 2: High fevers or temporary metabolic abnormalities, such as abnormal blood levels of sugar (glucose), calcium, magnesium, vitamin B₆, or sodium, can trigger one or more seizures. Seizures do not occur once the fever or abnormality resolves. If the seizures recur without such triggers, the cause is likely to be an injury during birth, a birth defect, or a hereditary metabolic abnormality or brain disorder.

2 to 14 years: Often, the cause is unknown.

After age 25: A head injury, stroke, or tumor may damage the brain, causing a seizure. Alcohol withdrawal (caused by suddenly stopping drinking) is a common cause of seizures. However, in about half of people in this age group, the cause is unknown.

Seizures with no identifiable cause are called idiopathic.

Conditions that irritate the brain—such as injuries, certain drugs, sleep deprivation, infections, fever—or that deprive the brain of oxygen or fuel—such as abnormal heart rhythms, a low level of oxygen in
the blood, or a very low level of sugar in the blood—can trigger a single seizure whether a person has a seizure disorder or not. A single seizure that results from such a stimulus is called a provoked seizure (and thus is a nonepileptic seizure). People with a seizure disorder are more likely to have a seizure when they are under excess physical or emotional stress or deprived of sleep. Avoiding these conditions can help prevent seizures.

Rarely, seizures are triggered by repetitive sounds, flashing lights, video games, or even touching certain parts of the body. In such cases, the disorder is called reflex epilepsy.

About 20% of people who have seizures experience an aura prior to the seizure. These unusual sensations may include: abnormal smells or tastes, butterflies in the stomach, a feeling of déjà vu or an intense feeling that a seizure is about to begin.

**Classification of seizures**

Seizures can be clinically classified as generalized or partial. **Generalized** seizures begin as an electrical discharge in a small area of the brain but spread to involve the entire cerebral cortex, causing widespread malfunction. **Partial** seizures remain confined to a limited portion of the brain, causing localized malfunction or may spread and become generalized.

**Simple Partial Seizures** – “Simple” means that consciousness is not impaired and “partial” means that only part of the cortex is disrupted by the seizure. The symptoms of simple partial seizures vary from one patient to another and depend entirely on where the seizure originates in the brain. A seizure that begins in the occipital cortex may result in flashing lights, while a seizure that affects the motor cortex will result in rhythmic jerking movements of the face, arm, or leg on the side of the body opposite to the involved cortex (Jacksonian seizure).

**Symptoms of simple partial seizures**

<table>
<thead>
<tr>
<th>Black out</th>
<th>Breathing difficulty</th>
<th>Chewing movements</th>
<th>Confusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deja-vu</td>
<td>Dizziness</td>
<td>Drooling</td>
<td>Electric shocks</td>
</tr>
<tr>
<td>Eyelid fluttering</td>
<td>Eyes rolling up</td>
<td>Falling down</td>
<td>Foot stomping</td>
</tr>
<tr>
<td>Hand waving</td>
<td>Heart racing</td>
<td>Unable to move</td>
<td>Incontinence</td>
</tr>
<tr>
<td>Lip smacking</td>
<td>Making sounds</td>
<td>Memory loss</td>
<td>Racing thoughts</td>
</tr>
<tr>
<td>Running</td>
<td>Shaking</td>
<td>Spacing out</td>
<td>Spinning feeling</td>
</tr>
<tr>
<td>Staring</td>
<td>Stiffening</td>
<td>Swallowing</td>
<td>Talking difficulty</td>
</tr>
<tr>
<td>Teeth clenching</td>
<td>Tongue biting</td>
<td>Tremors</td>
<td>Twitching</td>
</tr>
<tr>
<td>Undressing</td>
<td>Visual distortion</td>
<td>Visual loss or blurring</td>
<td>Walking</td>
</tr>
</tbody>
</table>

![Simple Partial Seizures Diagram](image)
**Complex partial seizures** – Complex (loss of consciousness and awareness) partial (only part of the cortex is disrupted) are the most common type of seizure in epileptic adults. During the seizure patient appear to be awake but are not in contact with others in their environment and do not respond normally to instructions or questions. They often seem to stare into space and either remain motionless or engage in repetitive behaviors such as facial grimacing, gesturing, chewing, lip smacking, snapping fingers, repeating words or phrases, walking, running, or undressing. Patients may become hostile or aggressive if physically restrained during complex partial seizures.

Complex partial seizures typically last less than three minutes and may be immediately preceded by a simple partial seizure. Afterward, the patient enters the postictal phase. The patient has no memory of what took place during the seizure other than, perhaps the aura.

**Generalized seizures** – In contrast to partial seizures, generalized seizures originate virtually in all the regions of the cortex. There are several types of generalized seizures.

- Absence seizures (also called petit mal) usually occur during childhood and typically last between 5 and 10 seconds. They frequently occur in clusters and may take place dozens or even hundreds of times a day. Absence seizures cause sudden staring with impaired consciousness. If an absence seizure lasts for 10 seconds or more, they may also be eye blinking and lip smacking.

- A generalized tonic-clonic seizure (also called grand mal seizure, major motor seizure, or convulsion) is the most dramatic type of seizure. It begins with an abrupt loss of consciousness, often in association with a scream or shriek. All of the muscles of the arms and legs as well as the chest and back then become stiff. The patient may begin to appear cyanotic during this tonic
phase. After approximately one minute, the muscles begin to jerk and twitch for an additional one to two minutes. During this clonic phase the tongue can be bitten and frothy and bloody sputum may by seen coming out of the mouth. The postictal phase begins once the twitching movements end. The patient is initially in a deep sleep, breathing deeply and then gradually wakes up, often complaining of a headache.

- Clonic seizures cause rhythmical jerking muscle contractions that usually involve the arms, neck and face.

- Myoclonic seizures consist of sudden, brief muscle contractions that may occur singly or in clusters and that can affect any group of muscles, although typically the arms are affected. Consciousness is usually not impaired.

- Tonic seizures cause sudden muscle stiffening, often associated with impaired consciousness and falling to the ground.
• Atonic seizures (also known as drop seizures) produce the opposite effect of tonic seizures – a sudden loss of control of the muscles, particularly of the legs, that result in collapsing to the ground and possible injuries.

The behaviors that typify absence seizures and generalized tonic-clonic seizures are not specific for epileptic seizures and may be observed in association with non-epileptic seizures.

**Postictal state** - Following the end of a seizure, there is a period of transition from the ictal (of or relating to a seizure) state back to the individual’s normal level of awareness and function. This interval is referred to as the “postictal period” and signifies the recovery period for the brain. It may last from seconds to minutes to hours, depending upon several factors including which part(s) of the brain were affected by the seizure, the length of the seizure, whether the individual was on antiepileptic drugs, and age. As an example, young adults with partial seizures of frontal lobe origin may have postictal states that last only several seconds, while elderly patients with generalized seizures may have postictal confusion and sleepiness that persists for several days to a week. If a person had a complex partial seizure or convulsion, his or her level of awareness gradually improves during the postictal period, much like a person waking up from anesthesia after an operation.

**Management of Seizures**

The two main goals in managing a patient with seizure activity are to protect the airway and protect the patient from harm. Therefore field management of the seizure patient generally includes the following procedures:

⇒ Ensure scene safety
⇒ Maintain the airway. Do not force objects between the patient’s teeth – this includes a bite block. Pushing objects into the patient’s mouth may cause him to vomit or to aspirate. It can also cause laryngospasm.
⇒ Vomiting and aspiration precautions. Suction prn
⇒ Administer high-flow oxygen
⇒ Never attempt to restrain the patient. This may injure him. Remove obstacles in the patient’s immediate area.
⇒ If generalized tonic-clonic convulsive activity present establish NS IV if able and administer an anticonvulsant:
  Adults: Versed (Midazolam) 2mg increments every 30 – 60 sec IVP (0.2mg/kg IN) up to 10 mg to stop seizures. May repeat to a total of 20mg if SBP >90.
  Peds: Versed 0.1mg/kg IV/IO (0.2mg/kg IN), max single dose 5mg. In no IV/IN/IO may give IM. May repeat to a total of 10 mg.
   Or
   May use patients IR Diastat (diazepam) 0.5mg/kg (max 20mg)
⇒ Maintain body temperature
⇒ Position patient on his left side after the clonic – tonic phase.
⇒ Monitor cardiac rhythm, VS and oximetry.
⇒ Determine the patient’s blood sugar. If patient is hypoglycemic administer Dextrose or Glucagon per the hypoglycemic SOP
⇒ Provide a quiet, reassuring atmosphere
⇒ Transport the patient in the supine or lateral recumbent position.
Syncope

Syncope is a temporary loss of consciousness and muscle tone. Sometimes a person with syncope can have muscle twitching that a bystander may misinterpret as a seizure.

### Comparison between Seizure and Syncope

<table>
<thead>
<tr>
<th>Syncope</th>
<th>Seizures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cause: increased parasympathetic tone</td>
<td>Cause: epilepsy, hypoxia, trauma, etc.</td>
</tr>
<tr>
<td>May be light-headed or dizzy prior to event</td>
<td>May have aura prior to event</td>
</tr>
<tr>
<td>Sudden onset of LOC with immediate return to consciousness when prone or supine</td>
<td>Sudden onset of LOC that persists for several minutes</td>
</tr>
<tr>
<td>Skin: cool, moist, pale</td>
<td>Tonic-clonic activity, or other repetitive muscular activity noted</td>
</tr>
<tr>
<td>Some muscle twitching may be noted but nothing organized or resembling tonic-clonic activity</td>
<td>Patient may urinate or defecate</td>
</tr>
<tr>
<td>The patient may sustain an injury during the fall (uncommon event)</td>
<td>Soft tissue, bone or spinal injury may occur</td>
</tr>
<tr>
<td>Treatment: none required, but positioning with legs elevated may result in faster recovery</td>
<td>Gradual return to consciousness following postictal state</td>
</tr>
<tr>
<td></td>
<td>Treatment: Varies from supportive care to resuscitation of ABCs</td>
</tr>
</tbody>
</table>

Causes of syncope can be divided into 4 general categories:

- Cardiovascular – a rhythm or mechanical problem
- Hypovolemia
- Noncardiovascular condition – hypoglycemia (metabolic), TIA (neurologic) or anxiety attack (psychiatric)
- Idiopathic – unknown cause after diagnostic workup

### Management

Attempt to identify the underlying cause and treat it. If no cause identified, supportive care should be given.
NAME: ______________________________ DATE: __________________

1. The American Heart Association has defined two primary categories of stroke: _________ and _________.

2. Approximately 85% of all strokes are hemorrhagic.
   a. True
   b. False

3. Ischemic strokes are further classified as either ________, ________, or _________________.

4. Match the type of ischemic stroke with its characteristics.

<table>
<thead>
<tr>
<th>Thrombolic</th>
<th>A. Altered mental status and/or loss of speech, sensory or motor function, develop e quickly. Often are associated with an identifiable cause (e.g. atrial fib).</th>
</tr>
</thead>
<tbody>
<tr>
<td>Embolic</td>
<td>B. Symptoms of brain dysfunction typically are diffuse and non-focal in contrast to the other two categories of ischemic stroke.</td>
</tr>
<tr>
<td>Systemic</td>
<td>C. Signs and symptoms develop gradually. This type of stroke often occurs at night with the patient awakening with altered mental status and/or loss of speech, sensory or motor function.</td>
</tr>
</tbody>
</table>

5. Describe the three assessments done in the Cincinnati Stroke Scale.

6. The most common causes of intracerebral hemorrhage are hypertension, trauma, vascular malformations and illicit drug use.
   a. True
   b. False
7. Scene time for a suspected stroke patient should be less than _____ minutes

8. It is necessary to document in your written report as well as notifying the hospital the exact time of onset of the patient’s symptoms.
   a. True
   b. False

9. A seizure is a temporary alteration in behavior due to ____________________________________________.

10. Seizures are divided into 2 basic categories, list and define them.

    ____________________________________________
    ____________________________________________

11. List the most common causes of seizures by age group:
    Before age 2 ____________________________________________
    2 to 14 years ____________________________________________
    After age 25 ____________________________________________

12. List 6 possible symptoms of a simple partial seizure.
    ______________________
    ______________________
    ______________________
    ______________________
    ______________________
    ______________________

13. The two main goals in the management of a seizure patient are to ____________________________
    and ____________________________.

14. What is the adult dose of Versed for a patient who is experiencing a seizure.

15. It is permissible to administer a patient’s dose of Diastat (diazepam) 0.5mg/kg (max dose 20mg) IR if parents ask you to.
   a. True
   b. False