Neurologic Emergencies

National EMS Education Standards

Anatomy and Physiology
Applies complex knowledge of the anatomy and function of all human systems to the practice of EMS.

Medicine
Applies fundamental knowledge to provide basic and selected advanced emergency care and transportation based on assessment findings for an acutely ill patient.

Review
As an EMT-I, you know about the importance of the neurologic system. You should have a good understanding of various causes of altered mental status, including hypoxia, diabetes, stroke, and seizures. Hypoglycemia associated with diabetes is a common cause of altered mental status and should be considered whenever you encounter any patient who is not completely alert and oriented. A patient experiencing a stroke or seizure or a hypoxic patient may also present with altered mental status. A complete physical assessment and patient history may help you determine the cause of the altered mental status and provide appropriate emergency medical care.

What’s New
This chapter explains the pathophysiology of specific neurologic disorders including headaches, strokes, transient ischemic attacks (TIAs), seizures, and altered mental status. In addition, you will review the different types of strokes and seizures to reinforce your knowledge in these areas. The information provided will help you to better understand, communicate with, and care for patients who have experienced a neurologic emergency.

Introduction
According to the National Center for Health Statistics, three of the top 15 causes of death in the United States in 2003 were neurologic: stroke, neoplasms (cancer), and Alzheimer disease. In the United States someone has a stroke every 45 seconds. Clearly, AEMTs will encounter many neurologic emergencies.

This chapter describes the structure and function of the brain and the most common causes of brain disorders, including headaches, strokes, transient ischemic attacks (TIAs), seizures, and altered mental status.

Anatomy and Physiology Review
The brain is the body’s computer. It controls breathing, speech, and all other body functions. All of your thoughts, memories, wants, needs, and desires reside in the brain. Different parts of the brain perform different functions. For example, some parts of the brain receive input from the senses, including sight, hearing, taste, smell, and touch; others control the muscles and movement; and still others control the formation of speech.

The brain is divided into three major parts: the brainstem; the cerebellum; and the largest part, the cerebrum.
conducted signal from one nerve cell (a neuron) and relay it to the next cell. Nerve cells respond to these signals in an all-or-nothing manner: They fire or they do not fire. A neuron cannot fire weakly.

How do the neurotransmitters achieve a greater degree of control than that permitted by simply wiring the cells together? The answer lies in the connections made as the signal travels from the cell to the synapse.

Figure 12-3

1. The first neuron fires and sends a signal along its axon to the axon terminal.
2. The impulse reaches the axon terminal, where neurotransmitters are released and trickle across the synapse.
3. Dendrites detect these chemicals and are triggered to send the signal to the cell's nucleus, which then transmits it down that axon, and so on.
4. Dendrites release neurotransmitter deactivators so that one impulse from cell one generates one response from cell two.

Synapses The gaps between nerve cells across which nervous stimuli are transmitted.

Neurotransmitters The chemicals produced by the body that stimulate electrical reactions in adjacent neurons.

Axon A projection from a neuron that makes connections with adjacent cells.

Table 12-1 summarizes the structures of the nervous system and their functions.
### Table 12-1
Strucures of the Nervous System and General Functions

<table>
<thead>
<tr>
<th>Major Structure</th>
<th>Subdivision</th>
<th>General Function</th>
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<tr>
<td><strong>Central Nervous System</strong></td>
<td></td>
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<tr>
<td>Brain</td>
<td>Occipital</td>
<td>Vision and storage of visual memories</td>
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<td></td>
<td>Parietal</td>
<td>Sense of touch and texture; storage of those memories</td>
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<tr>
<td></td>
<td>Temporal</td>
<td>Hearing and smell; language; storage of sound and odor memories</td>
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<tr>
<td></td>
<td>Frontal</td>
<td>Voluntary muscle control; storage of those memories</td>
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<tr>
<td></td>
<td>Prefrontal</td>
<td>Judgment and predicting consequences of actions; abstract intellectual functions</td>
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<td></td>
<td>Limbic system</td>
<td>Basic emotions; basic reflexes (such as chewing and swallowing)</td>
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<td></td>
<td>Diencephalon (thalamus)</td>
<td>Relay center; filters important signals from routine signals</td>
</tr>
<tr>
<td>Brainstem</td>
<td>Diencephalon (hypothalamus)</td>
<td>Emotions; temperature control; interaction with endocrine system</td>
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<tr>
<td></td>
<td>Midbrain</td>
<td>Level of consciousness; reticular activating system; muscle tone and posture</td>
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<tr>
<td></td>
<td>Pons</td>
<td>Respiratory patterning and depth</td>
</tr>
<tr>
<td></td>
<td>Medulla oblongata</td>
<td>Heart rate; blood pressure; respiratory rate</td>
</tr>
<tr>
<td>Spinal cord</td>
<td>Not applicable</td>
<td>Reflexes; relays information to and from body</td>
</tr>
<tr>
<td><strong>Peripheral Nervous System</strong></td>
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<tr>
<td>Cranial nerves</td>
<td>Not applicable</td>
<td>Brain to body-part communication, including “body parts” within the skull;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>special peripheral nerves that connect directly to body parts</td>
</tr>
<tr>
<td>Peripheral nerves</td>
<td>Not applicable</td>
<td>Brain to spinal cord to body-part communication; receive stimuli from body;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>send commands to body</td>
</tr>
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</table>
**Pathophysiology**

Stroke is a common brain disorder that is potentially treatable. Other brain disorders include coma, infection, and tumor. Although these specific problems are not addressed, the seizures or AMS that often accompanies them are discussed. The information in this section will help you better understand, communicate with, and care for patients who have experienced some type of brain disorder.

**Heeadaches**

Tension headaches, migraines, and sinus headaches are the most common types of headaches and are not considered life threatening, although they may be debilitating for the patient. Tension headaches are the most common type of headache. These headaches are caused by muscle contractions in the head and neck and are attributed to stress. The jaw, neck, or shoulders may be stiff or sore. Patients usually describe the pain as squeezing or dull or as an ache. This type of headache does not have any associated symptoms and usually does not require medical attention.

Migraine headaches are thought to be caused by changes in blood vessel size within the base of the brain. The patient may experience an aura (for example, seeing bright lights) and unilateral, focused pain that then spreads over time. The pain is throbbing, pounding, or pulsating. Nausea or vomiting may be present as well as photophobia. During a migraine headache, patients prefer dark, quiet environments. Migraines can last several days.

Two other types of headaches are cluster headaches and sinus headaches. Cluster headaches are rare vascular headaches that may recur for days and then stop entirely. They may return the next month. The pattern consists of minor pain around one eye, pain that quickly intensifies and spreads to one side of the face, and a feeling of anxiety. Sinus headaches are caused by inflammation or infection within the sinus cavities of the face. The pain is located in the superior portions of the face and increases with bending the head forward.

**Stroke**

A cerebrovascular accident (CVA), or stroke, is an interruption of blood flow to the brain that is often sudden and results in the loss of function in the affected part of the brain. Without oxygen, brain cells stop working and begin to die; these dead cells are called infarcted cells. Once the cells are dead, medical science has little to offer. However, it may take several hours or more for cell death to occur, even when it appears that severe disability will occur. In some cases, small amounts of blood may still be getting through to the affected area of the brain. This blood may supply enough oxygen to keep a larger group of brain cells alive, but not enough to let the cells work properly and perform their given jobs. For example, if ischemic cells are responsible for controlling the left arm, the patient will experience a decreased ability to move that arm or may not be able to move it at all. If normal blood flow is restored to that area of the brain in a timely manner, the patient may regain use of the arm.

Cerebrovascular accident (CVA) An interruption of blood flow to the brain that results in the loss of brain function; also referred to as a stroke or brain attack.

**Stroke** A loss of brain function in certain brain cells that do not get enough oxygen during a cerebrovascular accident; usually caused by obstruction of the blood vessels in the brain that feed oxygen to the brain cells.

Infarcted cells The cells that die as a result of loss of blood flow.

Ischemic cells The cells that receive enough blood after an event, such as a cerebrovascular accident, to stay alive but not enough to function properly.

**Transition Tip**

A stroke is also called a “brain attack.” This phrase is used with the general public to emphasize that rapid recognition of the signs and symptoms and prompt transport to an appropriate facility can mean the difference between the patient regaining function and needing lifetime care.

Interruption of cerebral blood flow may result from a thrombus, a clot that has developed locally, in this case, in a cerebral artery; an arterial rupture, rupture of a cerebral artery; or a cerebral embolism, obstruction of a cerebral artery caused by a clot that was formed elsewhere, detached, and traveled to the brain.

Thrombus In terms of neurologic emergencies, the local clotting of blood in the cerebral arteries that may result in the interruption of cerebral blood flow and subsequent stroke.

Arterial rupture The rupture of an artery, involvement of a cerebral artery may contribute to interruption of cerebral blood flow.

Cerebral embolism Obstruction of a cerebral artery caused by a clot that was formed elsewhere in the body and traveled to the brain.

There are two main types of stroke: ischemic (from an embolism or thrombus) and hemorrhagic (from arterial rupture).

**Ischemic Stroke**

When blood flow to a particular part of the brain is cut off by a blockage inside a cerebral artery, the result is an ischemic stroke. This can be from a thrombus or an embolism that obstructs blood flow. As with coronary artery disease, atherosclerosis in the blood vessels is usually the cause. Atherosclerosis is a disorder in which calcium and cholesterol build up, forming a plaque inside the walls of blood vessels. This plaque obstructs blood flow, interfering with the
and size of the ruptured cerebral vessel. As bleeding continues within the brain, intracranial pressure (ICP) increases and compresses brain tissue. When brain tissue is compressed, oxygenated blood cannot get into the area and the surrounding cells begin to die.

**Hemorrhagic stroke** One of the two main types of stroke; occurs as a result of bleeding inside the brain.

Certain patients are at higher risk for hemorrhagic stroke. The patients at highest risk are those who have chronic, poorly controlled hypertension. After many years of high pressure, the blood vessels in the brain weaken, making them prone to rupture. Proper treatment of hypertension can help prevent this long-term damage to the blood vessels. Cerebral hemorrhages are often fatal although proper treatment of high blood pressure can help prevent this long-term damage to the blood vessels, reducing morbidity and mortality.

People who have been born with weaknesses, called aneurysms, in the walls of the arteries are also at increased risk for hemorrhagic stroke. Aneurysms occur in the following way:

1. A small tear or defect occurs within the wall of an artery.
2. Blood penetrates between the layers of the artery.
3. Pressure builds up and the initial small tear increases in size.
4. If the buildup continues, the wall will become so damaged that it can no longer withstand the normal pressure of blood within it. A bulge may then develop. If the weakness is severe, the bulge may leak or fail catastrophically, causing an intracranial hemorrhage.

**Ischemic stroke** One of the two main types of stroke; occurs when blood flow to a particular part of the brain is cut off by a blockage (for example, a clot) inside a blood vessel.

**Atherosclerosis** A disorder in which cholesterol and calcium build up inside the walls of blood vessels, forming plaque, which eventually leads to partial or complete blockage of blood flow; a plaque can become a site where blood clots can form, detach, and travel elsewhere in the circulatory system (embolize).

If the blockage in the carotid artery is incomplete, smaller pieces of the clot may embolize (detach and travel) deep into the brain. There, a piece of clot will lodge in a branch of a cerebral artery. This cerebral embolism then obstructs blood flow. Depending on the location of the obstruction, the patient may experience anything from few symptoms to an inability to move one side of the body or complete paralysis.

**Hemorrhagic Stroke**

A hemorrhagic stroke occurs as a result of bleeding within the brain, typically when a cerebral artery ruptures. The severity of the hemorrhagic stroke depends on the location and size of the ruptured cerebral vessel. As bleeding continues within the brain, intracranial pressure (ICP) increases and compresses brain tissue. When brain tissue is compressed, oxygenated blood cannot get into the area and the surrounding cells begin to die.

Atherosclerosis can damage the wall of a cerebral artery, producing narrowing or a clot. When the vessel is narrowed or completely blocked, blood flow to that part of the brain may be blocked and the cells begin to die.

An embolus, a blood clot usually formed on a diseased heart valve, can travel through the body’s vascular system, lodge in a cerebral artery, and cause a stroke.
Many people with a hemorrhagic stroke caused by a ruptured aneurysm have a sudden onset of a severe headache, frequently described as “the worst headache of my life,” which signals the rupture of the aneurysm. Shorty after experiencing the severe headache, it is common for the patient’s level of consciousness (LOC) to rapidly decrease, indicating increased ICP. When a hemorrhagic stroke occurs in an otherwise healthy young person, it is often the result of a berry aneurysm. This type of aneurysm resembles a tiny balloon (or berry) that protrudes from a cerebral artery. When the aneurysm is overstretched and ruptures, bleeding occurs in the subarachnoid space—the area between the coverings (meninges) of the brain. Therefore, these types of strokes are called subarachnoid hemorrhages. With prompt care, surgical repair of the aneurysm is possible. Continued bleeding within the brain will cause the ICP to increase further, thus decreasing cerebral perfusion pressure. Eventually the brain, which is significantly compressed, will be forced out of the cranial vault through the foramen magnum in a process called herniation. With herniation, pressure on the medulla oblongata located directly above the spinal cord can result in rather bizarre vital signs and other findings, including slowed heart and erratic respiratory rates, eventually leading to death.

**Intracranial Pressure**
Hemorrhagic strokes that cause bleeding into the brain place patients at risk for increased intracranial pressure (ICP). Treatment is directed at providing some degree of control over this potentially deadly effect.

The skull (cranial vault) is filled with three substances: brain, blood, and cerebrospinal fluid. These substances exert a pressure (ICP) against the skull and the skull in turn exerts a reflected pressure. This balanced exchange allows the brain to fit snugly within the skull without permitting any voids. If the skull contained empty spaces, the brain would slam into the skull and cause damage with head movement.

When the pressure within the cranial vault begins to climb and remains high, it creates two major problems. The brain may become ischemic as a result of lack of blood supply or herniate (push through the ligaments that compartmentalize the brain).

As the ICP rises, the amount of blood available to the brain decreases. Cerebral perfusion pressure, the pressure of blood within the cranial vault, then begins to fall.

The ICP changes constantly. Coughing, vomiting, and bearing down, for example, will increase the ICP. These momentary spikes in ICP are not harmful. By contrast, if there is blood, swelling, pus, or a tumor within the cranial vault, the ICP will increase and remain high. Because the volume of the cranial vault is limited and inflexible, pressure increases as more substances squeeze into this space.

As long as there is no significant drop in blood pressure or significant rise in ICP, the heart will still be able to get blood into the brain. However, if the ICP rises sharply or blood pressure falls critically, patients may experience serious problems. Prehospital treatment is not very effective at decreasing the ICP.

**Transient Ischemic Attack**
In some patients, normal processes in the body will destroy a blood clot in the brain. When that happens quickly, blood flow is restored to the affected area, and the patient will regain use of the affected region of the body. When stroke symptoms subside within 24 hours, the event is called a transient ischemic attack (TIA), also referred to as a “small stroke” or a “ministroke.”

Although most patients with TIAs do well, they still represent a neurologic emergency. A TIA may be a warning sign that a larger, full stroke is imminent. For this reason, all patients with a TIA should be evaluated by a physician to determine whether preventive action can be taken.

**Signs and Symptoms of Stroke**

**Left Hemisphere Problems**
If the left cerebral hemisphere has been affected, the patient may have a speech disorder called aphasia (an inability to produce or understand speech). Speech problems vary widely. Patients may have trouble understanding speech but can speak clearly. This condition is called receptive aphasia. You can detect aphasia by asking the patient a question such as “What day is today?” In response, a patient with aphasia may say, “Green.” The speech is clear, but the answer does not make sense. Other patients will be able to understand the question but cannot produce the right sounds to answer. Only grunts or other incomprehensible sounds emerge. This type of aphasia is expressive. Strokes that affect the left side of the brain cause paralysis on the right side of the body and vice versa.

**Right Hemisphere Problems**
If the right cerebral hemisphere of the brain is not getting enough blood, patients will have trouble moving the muscles on the left side of the body. Usually, they will understand language and be able to speak, but their words may be slurred and difficult to understand. Slurred speech is one characteristic of dysarthria.
Meningitis is a consideration when dealing with pediatric patients exhibiting signs of increased intracranial pressure. A patient with bacterial meningitis can progress rapidly from appearing mildly ill to coma and even death.

Patients with meningococcal sepsis and meningitis get very sick very fast; so move quickly through your assessment. Form a general impression and perform a primary assessment as usual, keeping in mind that symptoms may be quite varied. Look for fever, altered mental status, bulging fontanelle, photophobia, nuchal rigidity, irritability, petechiae (small, pinpoint red spots), purpura (larger purple or black spots), and signs of shock. Assess glucose levels because hypoglycemia may result from the hypermetabolic state. Treat hypoglycemia with intravenous glucose.

Hypoglycemia
A condition characterized by a low blood glucose level.

Postictal state
The period following a seizure that lasts between 5 and 30 minutes, characterized by labored respirations and some degree of altered mental status.

Because oxygen and glucose are needed for brain metabolism, a patient with hypoglycemia may look like a patient who is having a stroke. You should check the patient's blood glucose level and find out whether the patient has diabetes and takes insulin or a glucose-lowering medication. A patient in the postictal state may appear to be having a stroke; however, in most cases a patient in a postictal state will recover spontaneously whereas a patient having a stroke will not.

Subdural and epidural bleeding (bleeding within the skull that compresses the brain) usually occur as a result of trauma. The dura is a leathery covering over the brain, next to the skull. A fracture near the temporal region of the skull may cause an artery (usually the middle meningeal artery) to bleed on top of the dura, resulting in pressure on the brain. Because the source of bleeding is from an artery, the onset of symptoms from epidural bleeding is usually very rapid after the injury. In other cases, the veins just below the dura may be torn and bleed, which is known as subdural bleeding. Because veins tend to bleed slowly, the onset of symptoms occurs more slowly, sometimes over several days.

With subdural bleeding, the onset of stroke-like signs and symptoms may be subtle. The patient or family may not even remember the original injury that is causing the bleeding.

Seizures
Seizures involve sudden, erratic firing of neurons. Patients who have epilepsy commonly have seizures, for example. Patients may experience a wide array of signs and symptoms when having seizures, ranging from one hand shaking...
or having a taste of pennies in the mouth to movement of every limb or the complete loss of consciousness. They may be aware of the seizure or they may wake up afterward not knowing what happened.

Seizures Episodes often characterized by generalized, uncoordinated muscular activity associated with loss of consciousness, a convulsion.

Types of Seizures
Seizures can be classified as generalized (affecting large portions of the brain) or partial (affecting a limited area of the brain). The classification of seizures is outlined in Table 12-2.

Within the category of generalized seizures are the tonic-clonic (formerly grand mal) and absence (formerly petit mal) types. Tonic-clonic seizures present AEMTs with

<table>
<thead>
<tr>
<th>Table 12-2 Seizure Classification</th>
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<tr>
<td><strong>Generalized Seizures</strong></td>
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<tr>
<td>Absence (formerly called petit mal) seizure</td>
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<tr>
<td>Tonic-clonic (formerly called grand mal) seizure</td>
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<tr>
<th><strong>Partial (Focal) Seizures</strong></th>
<th><strong>Characteristics</strong></th>
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<tbody>
<tr>
<td>Simple partial seizure</td>
<td>▪ Also referred to as focal motor seizure</td>
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<tr>
<td></td>
<td>▪ Characterized by tonic-clonic activity localized to one part of the body; may spread and progress to a generalized tonic-clonic seizure</td>
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<td>▪ No aura or associated loss of consciousness</td>
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<tr>
<td>Complex partial seizure</td>
<td>▪ Also referred to as temporal lobe or psychomotor seizure</td>
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<tr>
<td></td>
<td>▪ Manifests as changes in behavior (mood changes, abrupt bouts of rage)</td>
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<tr>
<td></td>
<td>▪ Often preceded by an aura</td>
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<tr>
<td></td>
<td>▪ Usually lasts less than 1 to 2 minutes, after which the patient quickly regains normal mental status (no postictal phase)</td>
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the most challenges. Most tonic-clonic seizures follow a pattern, traveling through each of the following steps in order, although sometimes skipping a step:

1. **Aura.** A sensation the patient experiences before the seizure occurs (for example, muscle twitch, odd taste, seeing lights, hearing a high-pitched noise)
2. **Loss of consciousness**
3. **Tonic phase.** Bodywide rigidity
4. **Hypertonic phase.** Arched back and rigidity
5. **Clonic phase.** Rhythmic contraction of major muscle groups; arm, leg, head movement; lip smacking; biting; teeth clenching
6. **Postseizure.** Major muscles relax; nystagmus (rhythmic shaking of the eyes) may still occur; eyes possibly rolled back
7. **Postictal.** Reset period of the brain. The reset can take several minutes to hours before the patient gradually returns to the preseizure LOC. **Figure 12-7**

During this time, patients are often initially aphasic (unable to speak), confused or unable to follow commands, very emotional, or tired or sleeping, and may be incontinent of urine and/or feces. They may present with a headache. Gradually the brain will begin to function normally.

**Tonic-clonic seizures** The seizures characterized by severe twitching of all of the body’s muscles that may last several minutes or more; formerly known as a grand mal seizure. **Aura** Sensations experienced before an attack occurs; common in seizures and migraine headaches. **Tonic phase** In a seizure, the steady, rigid muscle contractions with no relaxation. **Clonic phase** Seizure movement marked by repetitive muscle contractions and relaxations in rapid succession.

In contrast to tonic-clonic seizures, **absence seizures** present with little or no movement. The typical patient with absence seizures is a child. Classically, the child will simply stop moving; he or she may be walking and just stop, may be speaking and stop mid-sentence, or may be playing and freeze with a toy in the hand. The child will rarely fall. These seizures usually last no more than several seconds. There is no postictal period and no confusion. These may be brought on by flashing lights or hyperventilation.

**Partial seizures** may be classified as simple partial or complex partial. Such seizures involve only a limited portion of the brain. They may be localized to just one spot within the brain or they may begin in one spot and move in a wavelike manner to other locations.

**Simple partial seizures** involve movement of one part of the body (when originating in the frontal lobe) or altered sensations in one part of the body (when originating in the parietal lobe). This movement may stay in one body part or spread from one part to another in a wave. **Complex partial seizures** involve subtle changes in the LOC. The patient may become confused, lose alertness, have hallucinations, or be unable to speak. The head or eyes may make small movements. Patients typically do not become unresponsive.

**Absence seizures** The seizures that may be characterized by a brief lapse of attention in which the patient may stare and does not respond; formerly known as a petit mal seizure.

**Partial seizures** The seizures affecting a limited portion of the brain.

**Simple partial seizures** The seizures involving the movement of one part of the body or altered sensations in one part of the body; the movement may stay in one body part or spread from one part to another in a wave.

**Complex partial seizures** The seizures that involve subtle changes in the level of consciousness that may include confusion, less alertness, hallucinations, and inability to speak.

**Status Epilepticus**

**Status epilepticus** is a seizure that lasts for longer than 4 or 5 minutes or consecutive seizures that occur without the return of consciousness between seizure episodes. This time frame is arbitrary, however, and some authors suggest that status epilepticus does not occur until 20 minutes of uninterrupted seizures. Refer to your local protocols for guidelines on how long a seizure can continue before you should intervene.

**Status epilepticus** A condition in which seizures recur every few minutes without a lucid interval or last more than 4 or 5 minutes.

During a seizure, neurons are in a hypermetabolic state (using huge amounts of glucose and producing lactic acid). For a short period, this state does not produce long-term damage. If the seizure continues, however, the body cannot remove waste products effectively or ensure adequate glucose supplies. Such a hypermetabolic state can result in neurons being damaged or killed. The goals of prehospital care are to stop the seizure and ensure adequate ABCs.
Causes of Seizures

There are various reasons why a patient may have a seizure, ranging from a congenital disorder to a diabetic emergency to fever (a possible cause if the patient is an infant). Knowing the cause will help direct management.

Some seizure disorders such as epilepsy are congenital, meaning the patient was born with the condition. Other types of seizures may be caused by a high fever, structural problems in the brain, or metabolic or chemical problems in the body. (Table 12-3). Epileptic seizures can usually be controlled with medications such as phenytoin (Dilantin), phenobarbital (for example, Solfoton), carbamazepine (for example, Tegepot), gabapentin (Gabarone, Neurontin), or lamotrigine (Lamical). Patients with epilepsy often have seizures if they stop taking their medications or if they do not take an adequate dose. In fact, most seizures are the result of medication noncompliance. In the emergency department, blood analysis will frequently show a subtherapeutic level of the antiepileptic drug.

Seizures may also be caused by an area of abnormality in the brain such as a benign or cancerous tumor, an infection (brain abscess), or a scar from a previous injury. These seizures are said to have a structural cause; in other cases the seizures are metabolic. Metabolic causes include abnormal levels of certain blood chemicals (for example, an extremely low sodium level), hypoglycemia (low blood glucose level), poisons, drug overdoses, or sudden withdrawal from routine and heavy alcohol or sedative drug use or even from prescribed medications. Phenytoin (Dilantin), a drug that is used to control seizures, can cause seizures itself if the person takes too much. In some cases, seizures are idiopathic (of unknown cause).

Seizures can also result from sudden high fevers, particularly in infants and small children. Such seizures, known as febrile seizures, are usually unnerving for parents to observe but are generally well tolerated by the child. Nevertheless, you must transport a child who has had a febrile seizure because this condition needs to be evaluated in the hospital. The fact that a second seizure may occur is worrisome, and if it occurs the patient requires rapid evaluation in a hospital to identify possible causes such as serious inflammation in the brain or tissues covering the brain (conditions known as encephalitis and meningitis, respectively; infection also may be present). Febrile seizures result from a rapid increase in body temperature. In other words, it is not necessarily how high the fever gets, but how quickly it gets there.

**Febrile seizures** are the seizures that result from sudden high fever, particularly in children.

<table>
<thead>
<tr>
<th>Type</th>
<th>Cause</th>
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<tbody>
<tr>
<td>Epileptic</td>
<td>Congenital</td>
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<tr>
<td>Structural</td>
<td>Tumor (benign or cancerous)</td>
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<td>Infection (brain abscess)</td>
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<td>Scar from previous injury</td>
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<td>Head trauma</td>
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<td></td>
<td>Degenerative cerebral diseases</td>
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<tr>
<td>Metabolic</td>
<td>Abnormal blood chemical levels</td>
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<td></td>
<td>Hypoglycemia</td>
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<td>Poisoning</td>
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<td>Eclampsia</td>
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<td></td>
<td>Drug overdose</td>
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<td></td>
<td>Sudden withdrawal from alcohol or medications</td>
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<tr>
<td>Febrile</td>
<td>Sudden high fever</td>
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</table>

**The Importance of Recognizing Seizures**

Regardless of the type or cause of a seizure, it is extremely important for you to recognize when a seizure is occurring or whether one has already occurred. You must also determine whether this episode differs from any previous ones. For example, if a previous seizure occurred on only one side of the body and this seizure occurred over the entire body, some additional or new problem may be involved. In addition, recognizing that seizure activity has occurred and/or that something different may now be occurring, you must also recognize the postictal state and the complications of seizures.

Because most seizures involve vigorous twitching of the muscles, they use a lot of oxygen. This excessive demand consumes oxygen that was being delivered by the circulation to support the vital functions of the body. It is similar to a situation in which you exercise vigorously without giving your body a chance to rest. As a result, there is a buildup of acids in the bloodstream, and the patient may turn cyanotic (bluish lips, mucous membranes, and skin) from the lack of oxygen. Often the seizures themselves prevent the patient from breathing normally, making the problem worse.

Recognizing seizure activity also means looking at other problems associated with the seizure. For example, the patient may have fallen during the seizure episode and injured some part of the body; head injury is the most
Serious possibility. Patients having a generalized seizure may experience **incontinence**, meaning that they may lose bowel and/or bladder control. Therefore, one clue that unresponsive or confused patients may have had a seizure is to find that they were incontinent. Although incontinence is possible with other medical conditions, sudden incontinence is likely a sign that a seizure has occurred.

**Incontinence** Loss of bowel and bladder control; can be the result of a generalized seizure and other conditions.

---

**Transition Tip**

Be on the lookout for patients who may behave violently during the postictal phase. The patient might not know what has happened and might be frightened by strangers providing care or trying to move him or her into the ambulance. Most patients who have had a seizure pose no threat to EMS providers. Alcohol and/or drugs are not always associated with violent behavior during the postictal phase, but signs of their use or abuse should heighten your awareness of the potential for dangerous behavior.

---

**The Postictal State**

Once a seizure has stopped, the patient’s muscles relax, becoming almost flaccid, or floppy, and breathing becomes labored (fast and deep) in an attempt to compensate for the buildup of acids in the bloodstream. By breathing faster and more deeply, the body can balance the pH in the bloodstream. With normal circulation and liver function, the acids clear away within minutes, and the patient will begin to breathe normally. The longer the seizure was, the longer it will take for this imbalance to correct itself. Likewise, longer and more severe seizures will result in a longer postictal phase.

In some situations, the postictal state may be characterized by **hemiparesis**, or weakness on one side of the body, resembling a stroke. Unlike the typical stroke, hypoxic hemiparesis spontaneously resolves within a short period. Most commonly, the postictal state is characterized by lethargy and confusion to the point that the patient may be combative and appear angry. You must be prepared for these circumstances in your approach to scene control and in your treatment of the patient’s symptoms. If the patient’s condition does not improve, you should consider other possible underlying problems including hypoglycemia and infection.

**Hemiparesis** Weakness on one side of the body.

---

**Altered Mental Status**

Aside from stroke and seizures, the most common type of neurologic emergency that you will encounter is a patient with altered mental status. Simply put, altered mental status means that the patient is not thinking clearly or is incapable of being aroused. In some cases, patients will be unresponsive; in others, they may be responsive but confused. The range of problems is wide and the causes are many including common problems such as hypoglycemia (low blood glucose level), hypoxemia, intoxication, drug overdose, unrecognized head injury, brain infection, body temperature abnormalities; and uncommon conditions such as brain tumors, glandular abnormalities; and poisoning.

---

**Transition Tip**

Physician evaluation of a patient who has had a seizure depends heavily on reports of the seizure pattern and changes in that pattern. Record all pertinent information about the seizure in terms of duration, areas of body movement, and possible precipitating factors (such as recent trauma, fever, and medication noncompliance). Effective interviewing of available witnesses, family members, or caregivers is needed to obtain the required information.

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**Transition Tip**

Besides recognizing that a seizure has occurred, it is important to learn whether the pattern has changed. Was this seizure different from previous ones? If so, how?

---

**Hypoglycemia**

The clinical picture of patients with altered mental status due to hypoglycemia is complex. Patients might have signs and symptoms that mimic stroke and seizures. Patients may have hemiparesis, similar to what occurs as a result of a stroke. The principal difference, however, is that a patient who has had a stroke may be alert and attempting to communicate normally, whereas a patient with hypoglycemia almost always has an altered mental status.

Patients with hypoglycemia commonly, but not always, take medications that lower the blood glucose level. Thus, if the patient appears to have signs and symptoms of stroke and an altered mental status, you should report your findings to medical control and treat the patient accordingly. Check for and report medications but remember that not all patients who have diabetes take insulin or other medications to lower the blood glucose level. Remember also that patients with a decreased LOC should not be given anything by mouth. Local protocols should guide your actions.

Patients with hypoglycemia can also experience seizures, and you may arrive at the scene to find a patient in a postictal state: confused and disoriented or unresponsive. The mental status of a patient who has had a typical seizure is likely to improve; however, in a patient with hypoglycemia,
Syncope

Fainting, often caused by an interruption of blood flow to the brain.

A patient with syncope is usually in a standing position before the event occurs and then passes out. This is why you should always seat a patient before drawing blood or inserting an intravenous (IV) line.

**Patient Assessment**

Many different disorders can cause brain or other neurologic symptoms and thus can affect the patient’s LOC, speech, and voluntary muscle control. The key to identifying a neurologic problem is to look for obvious changes and subtle changes. Without any blood flow (cardiac arrest), the patient will go into a coma and can have permanent brain damage within minutes even if cardiopulmonary resuscitation is performed immediately. If there is poor blood supply to the middle part of the left cerebral hemisphere, the patient may not be able to move some parts of the right side of the body such as the right arm or the right leg. Facial muscles may also be affected on one side (one side of the face may appear to droop), the tongue may deviate to one side, or the patient may be unable to swallow.

**Scene Size-up**

Ensure that the scene is safe and follow standard precautions.

Scene considerations for a patient with a suspected neurologic emergency include an evaluation of the patient’s environment, assessing for any signs of potential trauma (mechanism of injury), indications of a previous medical condition such as diabetic supplies or medical alert tags, and evidence of a seizure. Be aware of indications of the nature of illness. Most patients with a neurologic emergency have a change in LOC and their ability to interact with their environment and others.

**Transition Tip**

When you are assessing a patient with altered mental status, consider the mnemonic AEIOU-TIPS.

A—Alcohol, acidosis
E—Encephalitis, epilepsy
I—Insulin
O—Overdose
U—Uremia
T—Trauma
I—Infection
P—Psychiatric
S—Seizures

**Primary Assessment**

As you approach the patient, note the patient’s body position and LOC. Observe for seizure activity. Most seizures will be
over by the time you arrive. If the seizure is still occurring, the potentially life-threatening condition of status epilepticus may be present. If the patient is in a postictal state, he or she may be unresponsive or starting to regain awareness of the surroundings. Determining the patient's LOC should be first in the list of assessment actions for anyone with an altered mental status.

Note the patient's posture. Decorticate or decerebrate posturing indicates the patient has severe brain dysfunction and is in critical condition. In **decorticate posturing**, the patient flexes the arms and curls them toward the chest. At the same time, he or she points his or her toes. Finally, the wrists are flexed. You can easily remember the meaning because with decorticate posturing, the patient's hands are flexed toward his or her core. In **decerebrate posturing**, the patient again points the toes, but now extends the arms outward and rotates the lower arms in a palms-down manner (called **pronation**). The wrists are again flexed. This posture is a more severe finding than decorticate posturing.

Ensure the patient's airway is clear and respirations are adequate. The greater the breathing rate deviates from normal, the more severely the nervous system is affected. Strokes affect how the body functions in many ways. Patients may have difficulty swallowing and are at risk for choking on their own saliva. Evaluate the airway of an unresponsive patient to make sure it is patent and will remain that way during transport. Continually reassess the patient closely for depressed respirations. If the patient requires assistance maintaining an airway, consider an oropharyngeal or nasopharyngeal airway. Provide suction, and position the patient to prevent aspiration. If you determine that the patient cannot protect his or her airway, place the patient in the recovery position to help prevent secretions from entering the airway. Suction as necessary.

Unless you are concerned about possible cervical spine fracture, elevate the head 30°. Provide ventilatory support at 16 to 20 breaths/min. Do not increase the rate any higher than 30 breaths/min because hyperventilation will cause vasoconstriction and decrease perfusion to the brain. Do not suction vigorously. Stimulating the cough and gag reflexes will increase ICP.

A patient who has had or is having a seizure may have been eating or chewing gum at the time of the seizure so there may be a foreign body obstruction. Bystanders may have tried to put objects in the patient's mouth to keep the person from swallowing the tongue, even though this practice is not advised. A seizure patient may clench his or her teeth (trismus) and require sedation. Call early for paramedic backup if dealing with a difficult airway.

Decorticate posturing: A body position in which the patient flexes the arms and curls them toward the chest, flexes the wrists, and points his or her toes; indicates severe brain dysfunction from pressure on the brainstem.

Decerebrate posturing: A body position in which the patient extends the arms outward and rotates the lower arms in a palms-down manner, and points the toes; indicates severe brain dysfunction from pressure on the brainstem.

Pronation: The act of extending the arms outward and turning the palms downward.

Trismus: The involuntary contraction of the mouth resulting in clenched teeth; occurs during seizures and head injuries.
hypertension). This set of conditions—known as the Cushing reflex—is the opposite of what is expected in shock. At this point in the examination, an AEMT may make a broad decision about whether to “load and go.” Unstable patients—those with inadequate or deteriorating ABCs or a significant mechanism of injury or nature of illness—should be transported urgently to an emergency department. Defer gathering very detailed information about patients in critical condition; instead, focus on stabilizing and maintaining the ABCs. With stable patients—that is, with normal primary assessment findings and a minor mechanism of injury or nature of illness—you have more time to gather detailed information at the scene. Rapidly transport any patient whom you suspect has increased ICP.

If you suspect the patient is experiencing a stroke, you should rapidly transport the patient to an appropriate facility to ensure that every chance is available to reduce the disability caused by an ischemic stroke. New therapies, such as fibrinolytic drugs, commonly referred to as “clot busters,” have been shown to reverse symptoms, thus aborting the stroke, if given within 3 hours after the onset of symptoms. It is also essential that they be taken to a stroke center or appropriate facility with a stroke team on duty. Your local protocols should address this or you should contact medical control to help choose the most appropriate destination. The sooner the treatment is initiated, the better the chance for a positive patient outcome. If you suspect the patient may have had a stroke, place him or her in a comfortable position, usually on one side, with the paralyzed side down and well protected with padding. The patient's head should be elevated about 6 inches.

### Transition Tip

**When you are working with geriatric patients, take their medical history into account.** Patients with a history of dementia could be complicated to manage. The primary question is: “How much change has occurred in the patient’s level of consciousness (LOC)?” Do not assume that the patient’s baseline LOC is what you would consider normal; speak to the family, friends, or other caregivers to determine the patient’s baseline LOC and document that level clearly.

After you begin transport, you should relay the information you have obtained to the receiving hospital. Be sure to include the time that the patient was last seen to be normal, the findings of your neurologic examination, and the time you anticipate arriving at the hospital. This information will allow the emergency department staff to allocate the appropriate resources for the patient’s arrival.

### History Taking

**Obtain a history from patients who are in stable condition and have minor complaints.** If the patient is unresponsive, you will need to gather any history of the present illness from family or bystanders. If no one is around, quickly look for explanations for the altered mental status (for example, signs of trauma, medical alert tags, track marks, and environmental clues such as empty alcohol or medication containers).

To determine the chief complaint in a responsive patient, begin by asking the patient what happened. Look for signs and symptoms that may indicate a cause for his or her altered mental status, such as a stroke, and determine whether there is any evidence of a seizure (such as incontinence or a bitten tongue). Evaluate the patient’s speech. Is the patient making any sense? Is speech slurred?

If you know that the patient has had a seizure and is now in a postictal state, you will not be able to obtain a history from the patient. Look for any obvious trauma or explanations as to why the patient may have had a seizure.

If the patient has a headache, try to determine the patient’s level of stress, possible infections, and history of headaches. Stroke patients can also experience headaches. If you suspect a more complicated problem, perform a rapid scan to ensure that you give the patient the best possible care.

If the patient is responsive and breathing, obtain a SAMPLE history. Also try to speak with family or friends who may be able to explain the events leading up to the altered mental status, remembering that time can be critical in a neurologic emergency. Make a special effort to determine when the patient last appeared to be healthy. This information will help physicians in the emergency department decide whether it is safe to begin certain treatments (for example, fibrinolytic therapy) that must be given within a narrow time frame after the onset of symptoms.

History taking from a patient with a potential neurologic complaint should follow the same process as for any other medical or trauma patient. The physical examination for this complaint should investigate potential cardiac, neurologic, respiratory, metabolic, and infectious causes.

Although a patient who has had a stroke may appear to be unresponsive and unable to speak, the patient may still be able to hear and understand what is taking place. Therefore, you should treat the patient as if he or she is able to hear. Try to communicate with the patient by looking for indications that the patient can understand you, such as a glance, gaze, motion or pressure of the hand, effort to speak, or head nod. Allow the patient to write responses if he or she is able. Reassure your patient that you understand that communication between the two of you may be difficult at this point but that you will provide him or her with continuous information as to what you and the other team members are doing. Establishing effective communication can help you to calm the patient and lessen the fear that accompanies an inability to communicate.

For patients who have had a seizure, your SAMPLE history should reveal whether the patient has a history of seizures. If so, it is important to find out how the patient’s
seizures typically occur and whether this episode differs in some way from previous episodes. You should also ask what medications the patient has been taking. If the patient takes phenytoin (Dilantin) and phenobarbital (for example, Solfoton), he or she most likely has a seizure disorder. You might find that the patient ran out of medication or stopped taking the medication for a time. Patients who have a history of seizures and diabetes may use up all the glucose in the body to fuel the seizure.

If the patient does not have a history of seizures and suddenly has a seizure, a serious condition such as a brain tumor, intracranial bleeding, or serious infection should be suspected. You should also determine whether the patient takes medications that lower the blood glucose level such as insulin and oral hypoglycemic agents. In other situations, you may want to inquire about drug use or exposure to poisons.

**Secondary Assessment**

As soon as possible, perform a secondary assessment. Look for potential causes of neurologic signs and symptoms such as trauma not previously noticed. Does the patient have any complaints related to the abdomen? Signs of nausea and vomiting are common with some neurologic conditions such as headaches and increased ICP. Note whether the patient is incontinent; urinary and fecal incontinence are common findings with seizures or syncope. The patient should also be assessed for injuries including head lacerations, shoulder dislocation, bitten tongue, and long bone fractures.

You should perform at least three key physical tests on patients you suspect of having had a stroke: tests of speech, facial movement, and arm movement. If any one of the three tests is positive (abnormal), the patient should be assumed to be having (or to have had) a stroke.

During the assessment phase, use a stroke assessment tool—the Cincinnati Prehospital Stroke Scale (Table 12-4) or the Los Angeles Prehospital Stroke Screen (Table 12-5). All patients with altered mental status (stroke, TIA, seizure, of unknown cause) should also have a Glasgow Coma Scale score calculated (Table 12-6).

Blood pressure must be closely monitored in any patient with a potential ICP problem. Frequent assessment becomes

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**Table 12-4**

Cincinnati Prehospital Stroke Scale

<table>
<thead>
<tr>
<th>Test</th>
<th>Normal</th>
<th>Abnormal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Facial droop</td>
<td>Both sides of face move equally well.</td>
<td>One side of face does not move as well as the other.</td>
</tr>
<tr>
<td>Arm drift</td>
<td>Both arms move the same, or both arms do not move.</td>
<td>One arm does not move, or one arm drifts down compared with the other side.</td>
</tr>
<tr>
<td>Speech</td>
<td>Patient uses correct words with no slurring.</td>
<td>Patient slurs words, uses inappropriate words, or is unable to speak.</td>
</tr>
</tbody>
</table>

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**Table 12-5**

Los Angeles Prehospital Stroke Screen

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Yes</th>
<th>Unknown</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Age &gt; 45</td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>2. History of seizures or epilepsy absent</td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>3. Symptoms &lt; 24 hours</td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>4. At baseline, patient is not wheelchair-bound or bedridden</td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>5. Blood glucose between 60 and 400 mg/dL</td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>6. Obvious asymmetry (right vs. left) in any of the following three exam categories (must be unilateral)*:</td>
<td>Equal</td>
<td>Right Weak</td>
<td>Left Weak</td>
</tr>
<tr>
<td>Facial smile/grinace</td>
<td>□</td>
<td>□ Droop</td>
<td>□ Droop</td>
</tr>
<tr>
<td>Grip</td>
<td>□</td>
<td>□ Weak grip</td>
<td>□ Weak grip</td>
</tr>
<tr>
<td>Drifts down</td>
<td>□</td>
<td>□ No grip</td>
<td>□ No grip</td>
</tr>
</tbody>
</table>

*Interpretation: If criteria 1–6 are marked yes, the probability of a stroke is 97%.

*Patients with strokes may have weakness or paralysis (hemiplegia) on one side of the body.
Routine monitoring should include heart rate, blood pressure, respiratory rate and pattern, pulse oximetry, repeated glucose level (if the level was low and glucose was given to the patient), and Glasgow Coma Scale scores. Continue oxygenation and ventilation support. Monitor the IV fluids closely to ensure that accidental fluid overload does not occur. If the patient’s condition undergoes a sudden dramatic change, repeat the assessment as if this were a new patient and modify your care.

Observe for recurrent seizures. If another seizure occurs, note whether it starts at a focal part of the body (for example, one arm or one leg) and then progresses to the rest of the body. Most important, evaluate the patient’s mental status and monitor it frequently to verify progressive improvement.

When your patient shows signs and/or symptoms of stroke, seizure, hypoglycemia, or hypoxia, these conditions typically can be relatively easily identified, and treatment options are readily available. With other neurologic emergencies, the cause of the patient’s symptoms will not always be obvious and you may not be able to determine the cause. It is possible that hospital staff will need more time and diagnostic testing to determine the cause. This may make it difficult for you to provide definitive treatment in the field. Most of your interventions will be based on your assessment findings. For example, if the blood glucose level is low, you may give oral glucose according to protocol, or if a patient is unresponsive, you may need to position him or her in the recovery position to protect the airway. Remember, never give anything orally to a patient with decreased mental status or a patient who is unable to swallow normally because doing so may result in aspiration. Your best treatment in these situations is to perform a thorough assessment and maintain the ABCs.

If you suspect the patient of having a stroke, continue giving 100% oxygen, or if needed, assisted ventilations en route. Establish IV access and obtain blood samples for analysis. Only give 50% dextrose if the patient’s blood glucose level is low. Consider the administration of glucagon for hypoglycemia as an alternative. Use an isotonic crystalloid solution at a keep-vein-open rate unless the patient is hypovolemic. If the patient is hypotensive, give a fluid bolus of 20 mL/kg to maintain adequate perfusion (for example, to maintain the radial pulses). Excessive fluids will increase bleeding in patients with hemorrhagic strokes as well as increase ICP.

If you cannot check the patient’s blood glucose level for some reason, you need to be more cautious in administering dextrose. In a situation in which the patient is unresponsive or has a decreased LOC and no blood glucose monitor is available, administer 12.5 g (½ syringe) and then reassess the response. Proceed with additional dextrose cautiously, based on responses to previous doses. Hyperglycemia can increase the morbidity rate among stroke patients.

Even more essential when a decrease in blood pressure is also present. For any patient at risk for increased ICP, AEMTs need to ensure a systolic blood pressure of at least 110 to 120 mm Hg.

Changes in pupil size and reactivity indicate significant bleeding and pressure on the brain. If the patient has an altered mental status (regardless of the cause), you should check the blood glucose level if you have the equipment available and your local protocol allows.

During most active seizures, it is impossible to evaluate vital signs nor is this the priority when a patient is having a seizure. Unless the situation is unusual, vital signs in a postictal state will approximate normal. Obtain pulse rate, rhythm, and quality; respiratory rate, rhythm, and quality; blood pressure; skin color, temperature, and condition; and pupil size and reactivity.

**Reassessment**

Reassessment is intended to monitor ABCs, vital signs, and interventions and to monitor patients for changes. Talk with them. Casual conversation will allow you to closely monitor brain functions. If the patient is nonverbal, keep a close eye on respiratory patterns and eye and body movements, and monitor for seizure activity.

<table>
<thead>
<tr>
<th>Test</th>
<th>Response</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eye opening</td>
<td>Spontaneous</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Voice</td>
<td>3</td>
</tr>
<tr>
<td>Pain stimulation</td>
<td>None</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Oriented conversation</td>
<td>5</td>
</tr>
<tr>
<td>Verbal</td>
<td>Confused conversation</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Inappropriate words</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Incomprehensible sounds</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>None</td>
<td>1</td>
</tr>
<tr>
<td>Motor</td>
<td>Obeyeds commands</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Localizes pain</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Withdraws from pain</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Abnormal flexion (decorticate)</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Abnormal extension (decerebrate)</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>None</td>
<td>1</td>
</tr>
</tbody>
</table>

Score: 15 indicates no neurologic disabilities.
Score: 13–14 may indicate mild dysfunction.
Score: 9–12 may indicate moderate dysfunction.
Score: 8 or less is indicative of severe dysfunction.

Table 12-6

<table>
<thead>
<tr>
<th>Test</th>
<th>Response</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eye opening</td>
<td>Spontaneous</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Voice</td>
<td>3</td>
</tr>
<tr>
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<td></td>
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<td></td>
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<tr>
<td></td>
<td>None</td>
<td>1</td>
</tr>
</tbody>
</table>
is bleeding in the brain. The only reliable way to determine bleeding in the brain is with advanced diagnostic imaging techniques such as CT scan or MRI. Blood is usually easy to see on either of these studies.

In most situations, patients who have had a seizure require definitive evaluation and treatment in the hospital. Unless the patient has a well-established history of seizures and is completely alert and oriented, supplemental oxygen is strongly advised, not only to provide extra oxygen but also to reduce the possibility of a recurrent seizure. It is never wrong to administer supplemental oxygen to a patient who has had a seizure.

For patients who are having a seizure, protect them from harm, maintain a clear airway by suctioning as necessary, and provide oxygen as quickly as possible. If trauma is suspected, provide spinal immobilization. With recurrent seizures, protect the patient from further injury and manage the airway once the seizure ceases.

For patients who continue to have a seizure, as in status epilepticus, suction the airway, provide positive-pressure ventilations, and transport quickly to the hospital. If you have the option to rendezvous with paramedics, you should do so. Paramedics can administer medications that can stop a prolonged seizure.

Notify the receiving facility of your patient’s chief complaint and your assessment findings. Most designated stroke centers will want you to call a stroke alert for patients you have assessed and found to be having a stroke (check local protocol). This will alert the stroke team members at the hospital and give them time to assemble their resources to treat the patient without delay. If anything changes en route to the hospital, manage the situation and document any changes or additional treatment.

**Emergency Medical Care**

Management for all patients who experience a change in LOC is directed at ensuring that the body has an adequate internal environment to allow for optimal brain function.

Provide emotional support for the patient and family. Neurologic emergencies can produce confusion, fear, anger, and helplessness. Use a calm, reassuring voice to show that you are there to help.

Consult your local protocol to determine whether the blood glucose reading is considered low. One guideline states that if the blood glucose level is below 60 mg/dL, glucose is needed. Two medications are available for pre-hospital treatment of hypoglycemia: dextrose 50% (D50) and glucagon.

Oral glucose administration is another option for patients with a decreased LOC who can swallow safely. Alternatives to oral glucose include cake icing, a plain chocolate bar, and orange juice with sugar added. Administration of sugar by mouth will take longer to raise the blood glucose level. Constantly supervise patients as they consume the sugar. To the extent possible, make sure they do not aspirate. Never administer anything by mouth to a patient you believe to be at risk for aspiration because of a decreased level of consciousness.

### Transition Tip

When you are assessing an infant for increased ICP, consider the quality of the cry. As the ICP increases, the pitch of the cry will increase until a shriek similar to that of a cat can be heard. At the same time, the shape of the pupils can change from round to more oval. These two findings lead to the saying related to infants and increased ICP: “cat’s eyes and cat’s cries.”

### Transition Tip

You may be the only provider to witness some patient activity, so accurate and complete documentation is critical to ensure continuity of care.

There is currently no safe way to lower a high blood glucose level in the field. For patients with hyperglycemia, provide standard care and ensure adequate blood pressure. Hyperglycemic patients are often dehydrated and usually need volume support. Of course this only corrects the dehydration, not the blood glucose level.

**Headaches**

Be cautious because headaches can indicate a more serious problem. Give standard care. Ask which medications the patient has taken. Many patients will appreciate a darkened, quiet environment, so do not use lights and sirens if transporting.

**Stroke**

Because it is often impossible to differentiate the symptoms of a TIA from a stroke, assume that a patient with TIA or stroke symptoms is having a stroke. Administer 100% supplemental oxygen, obtain IV access, and transport the patient to the closest appropriate facility for evaluation.

Most treatments for stroke must be started as soon as possible after the onset of the event. Few if any current treatments are effective if they are started more than 3 hours after the stroke begins. Even if 3 hours have passed since the onset of symptoms, prompt action on your part is essential.

As mentioned, fibrinolytic drugs need to be administered within 3 hours of stroke onset. Do not administer aspirin in the field; it will help in an ischemic CVA but hurt in a hemorrhagic CVA. Aspirin should be administered only after a CT scan or MRI has been completed in the hospital.
Table 12-7

Tips on Patient Care for a Possible Stroke Patient

Patients who experience a TIA typically have the same signs and symptoms as patients who have a stroke. These signs and symptoms can last from minutes up to 24 hours. Therefore, the signs of stroke that you note on arrival may gradually resolve. Patients who appear to have had a TIA should be transported for further evaluation.

Place the patient's affected or paralyzed extremity in a secure and safe position during patient movement and transport.

Some patients who have had a stroke may be unable to communicate but they can often understand what is being said around them. Be aware of this possibility.

New therapies for stroke must be used shortly after the onset of symptoms. Minimize time on the scene, and notify the receiving hospital as soon as possible.

Transient Ischemic Attack

As with strokes, management of TIAs begins with standard care. Follow the same management guidelines as for CVA. Close neurologic assessment is needed. Patients may experience multiple TIAs in a short time frame.

Strongly encourage the patient to be transported. If the patient refuses transportation, appeal to the patient's family for assistance. Encourage the patient to seek medical care very soon. Offer to return and tell the patient to call 9-1-1 again if he or she wants. It is important to reinforce the message that the TIA is a warning sign of a serious and potentially deadly problem with the blood vessels in the brain.

Seizures

During the seizure, respirations may become very erratic, loud, and obviously abnormal. Alternatively, the patient may stop breathing and become cyanotic. These periods of apnea are usually very short-lived and do not require assistance. If the patient is apneic for more than 30 seconds, immediately begin ventilatory assistance.

In most situations, patients who have had a seizure require definitive evaluation and treatment in the hospital. Even a patient who has a history of chronic epilepsy that is controlled with medications may have an occasional seizure, commonly referred to as a breakthrough seizure, and also should be taken to the hospital for evaluation. Administer 100% supplemental oxygen to any patient who has experienced a seizure, whether it is the first or whether the patient has chronic seizures. This intervention will help ameliorate any associated hypoxia. Gain IV access as a medication route even if fluid resuscitation is not needed. Note any medications the patient is currently taking and any previous seizures, the time of onset, the duration of the seizure activity, the number of seizures, and whether the patient was responsive between seizures. Provide spinal immobilization if trauma was involved or cannot be ruled out.

Depending on local protocols, you should assess and treat the patient for possible hypoglycemia (for example, a person with diabetes who has altered mental status and takes insulin or oral agents that lower the blood glucose level). Look for tongue lacerations and bleeding that may create an obstruction or lead to aspiration. With recurrent seizures, protect the patient from further injury and manage the airway as needed.

In all cases, you should be patient and tolerant because many of the patients are likely to be confused and occasionally frightened. Many patients who experience seizures are frustrated with their condition and may refuse transport. Compassion and professional behavior are required to help convince the patient that transport is necessary for definitive care.

Transition Tip

Children can have altered mental status caused by strokes, seizures, and other brain emergencies. However, children who have subarachnoid hemorrhages may not have a berry aneurysm; instead, they may have a congenital problem with the blood vessels in the brain known as an arteriovenous malformation. Children who have sickle cell anemia are at particularly high risk for ischemic stroke. Treat stroke in children the same way that you do in adults.

As mentioned, seizures can result from sudden high fever, particularly in children. If you are treating a child whom you suspect is having a febrile seizure, you should attempt to lower the body temperature by removing the child's clothing and cooling the child with tepid water, particularly around the head and neck, and then fanning the moistened areas. Be careful not to make the patient shiver, which will further increase temperature and precipitate another seizure.

Remember that although febrile seizures are generally well tolerated by children, you must transport them to the hospital. The possibility of a second seizure makes transport mandatory so that if other problems develop, the child is in the hospital and can receive immediate, definitive care.

If you suspect that a patient with altered mental status has hypoglycemia, you should test for it and treat the patient according to local protocols. Patients with hypoglycemia require close monitoring, particularly of the airway, en route to the hospital.
**Syncope**

Provide emotional support because syncope can be embarrassing. Transport the patient to the hospital. Syncope can be a sign of life-threatening cardiac arrhythmias, stroke, and other serious medical conditions. Call early for paramedic backup if needed.

Begin with standard care. Determine whether the patient may have experienced trauma during the fall, and take cervical spine precautions as needed. Focus on the blood glucose level and likely cardiac causes. Obtain orthostatic vital signs, if possible. Provide supplemental oxygen and gain IV access.
Case Study

You are providing EMS service at a local fair. It’s a hot summer day and you are doing your best to stay cool. Just as you are ready to go eat lunch, a fair official comes running over to you. He tells you that someone is unconscious in the midway tent. You grab your gear and follow the man toward the tent. When you arrive, you find a man in his 60s lying supine on the ground. Bystanders tell you that the patient was complaining of a headache for the past hour and then suddenly passed out. As you examine the patient, you note that he is responsive to verbal stimuli and appears confused. On further exam you note that he is flaccid on his left side and appears to be incontinent. His wife is present and tells you the patient has a history of TIAs and hypertension.

1. If this patient had a seizure, explain the reasoning behind the flaccidness on his left side.

2. This patient initially complained of a headache. Explain the difference between a tension headache and a migraine headache.

3. Perhaps this patient has experienced a hemorrhagic stroke. How does an epidural hematoma differ from a subarachnoid hemorrhage?

4. The bystanders report that just prior to your arrival the patient was shaking all over while unconscious. This most likely describes a:
   A. generalized seizure.
   B. simple partial seizure.
   C. complex partial seizure.
   D. restless leg syndrome.

5. This patient currently is responsive to verbal stimuli, appears confused, and localizes to pain. On the basis of this information, the patient’s Glasgow Coma Scale score is:
   A. 15.
   B. 14.
   C. 13.
   D. 12.