Cerebrovascular Accident

Stroke: English

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Cerebrovascular Accident or Stroke

What is Stroke?

A stroke occurs when the blood supply to part of the brain is suddenly interrupted or when a blood vessel in the brain bursts, spilling blood into the spaces surrounding brain cells. In the same way that a person suffering a loss of blood flow to the heart is said to be having a heart attack, a person with a loss of blood flow to the brain or sudden bleeding in the brain can be said to be having a "brain attack."

Brain cells die when they no longer receive oxygen and nutrients from the blood or when they are damaged by sudden bleeding into or around the brain. *Ischemia* is the term used to describe the loss of oxygen and nutrients for brain cells when there is inadequate blood flow. Ischemia ultimately leads to *infarction*, the death of brain cells which are eventually replaced by a fluid-filled cavity (or *infarct*) in the injured brain.

Even though a stroke occurs in the unseen reaches of the brain, the symptoms of a stroke are easy to spot. They include sudden numbness or weakness, especially on one side of the body; sudden confusion or trouble speaking or understanding speech; sudden trouble seeing in one or both eyes; sudden trouble walking, dizziness, or loss of balance or coordination; or sudden severe headache with no known cause. All of the symptoms of stroke appear suddenly, and often there is more than one symptom at the same time. Therefore stroke can usually be distinguished from other causes of dizziness or headache. These symptoms may indicate that a stroke has occurred and that medical attention is needed immediately.

There are two forms of stroke: *ischemic* - blockage of a blood vessel supplying the brain, and *hemorrhagic* - bleeding into or around the brain. The following sections describe these forms in detail.
Ischemic Stroke

An ischemic stroke occurs when an artery supplying the brain with blood becomes blocked, suddenly decreasing or stopping blood flow and ultimately causing a brain infarction. This type of stroke accounts for approximately 80 percent of all strokes. Blood clots are the most common cause of artery blockage and brain infarction. The process of clotting is necessary and beneficial throughout the body because it stops bleeding and allows repair of damaged areas of arteries or veins. However, when blood clots develop in the wrong place within an artery they can cause devastating injury by interfering with the normal flow of blood. Problems with clotting become more frequent as people age.

Blood clots can cause ischemia and infarction in two ways. A clot that forms in a part of the body other than the brain can travel through blood vessels and become wedged in a brain artery. This free-roaming clot is called an embolus and often forms in the heart. A stroke caused by an embolus is called an embolic stroke. The second kind of ischemic stroke, called a thrombotic stroke, is caused by thrombosis, the formation of a blood clot in one of the cerebral arteries that stays attached to the artery wall until it grows large enough to block blood flow.

Ischemic strokes can also be caused by stenosis, or a narrowing of the artery due to the buildup of plaque (a mixture of fatty substances, including cholesterol and other lipids) and blood clots along the artery wall. Stenosis can occur in large arteries and small arteries and is therefore called large vessel disease or small vessel disease, respectively. When a stroke occurs due to small vessel disease, a very small infarction results, sometimes called a lacunar infarction, from the French word "lacune" meaning "gap" or "cavity."

The most common blood vessel disease that causes stenosis is atherosclerosis. In atherosclerosis, deposits of plaque build up along the inner walls of large and medium-sized arteries, causing thickening, hardening, and loss of elasticity of artery walls and decreased blood flow.

Hemorrhagic Stroke

When an artery in the brain bursts, blood spews out into the surrounding tissue and upsets not only the blood supply but the delicate chemical balance neurons require to function. This is called a hemorrhagic stroke. Such strokes account for approximately 20 percent of all strokes.
Hemorrhage can occur in several ways. One common cause is a bleeding aneurysm, a weak or thin spot on an artery wall. Over time, these weak spots stretch or balloon out under high arterial pressure. The thin walls of these ballooning aneurysms can rupture and spill blood into the space surrounding brain cells.

Hemorrhage also occurs when arterial walls break open. Plaque-encrusted artery walls eventually lose their elasticity and become brittle and thin, prone to cracking. Hypertension, or high blood pressure, increases the risk that a brittle artery wall will give way and release blood into the surrounding brain tissue.

The subarachnoid space separates the arachnoid membrane from the underlying pia mater membrane. It contains a clear fluid (cerebrospinal fluid or CSF) as well as the small blood vessels that supply the outer surface of the brain. In a subarachnoid hemorrhage, one of the small arteries within the subarachnoid space bursts, flooding the area with blood and contaminating the cerebrospinal fluid. Since the CSF flows throughout the cranium, within the spaces of the brain, subarachnoid hemorrhage can lead to extensive damage throughout the brain. In fact, subarachnoid hemorrhage is the most deadly of all strokes.

Transient Ischemic Attacks

A transient ischemic attack (TIA), sometimes called a mini-stroke, starts just like a stroke but then resolves leaving no noticeable symptoms or deficits. The occurrence of a TIA is a warning that the person is at risk for a more serious and debilitating stroke. Of the approximately 50,000 Americans who have a TIA each year, about one-third will have an acute stroke sometime in the future. The addition of other risk factors compounds a person's risk for a recurrent stroke. The average duration of a TIA is a few minutes. For almost all TIAs, the symptoms go away within an hour. There is no way to tell whether symptoms will be just a TIA or persist and lead to death or disability. The patient should assume that all stroke symptoms signal an emergency and should not wait to see if they go away.
How Do You Recognize Stroke?

Symptoms of stroke appear suddenly. Watch for these symptoms and be prepared to act quickly for yourself or on behalf of someone you are with:

- Sudden numbness or weakness of the face, arm, or leg, especially on one side of the body.
- Sudden confusion, trouble talking, or understanding speech.
- Sudden trouble seeing in one or both eyes.
- Sudden trouble walking, dizziness, or loss of balance or coordination.
- Sudden severe headache with no known cause.

If you suspect you or someone you know is experiencing any of these symptoms indicative of a stroke, **do not wait. Call 911 emergency immediately.** There are now effective therapies for stroke that must be administered at a hospital, but they lose their effectiveness if not given within the first 3 hours after stroke symptoms appear. **Every minute counts!**

How is the Cause of Stroke Determined?

Physicians have several diagnostic techniques and imaging tools to help diagnose the cause of stroke quickly and accurately. The first step in diagnosis is a short neurological examination. When a possible stroke patient arrives at a hospital, a health care professional, usually a doctor or nurse, will ask the patient or a companion what happened and when the symptoms began. Blood tests, an electrocardiogram, and a brain scan, such CT or MRI, will often be done. One test that helps doctors judge the severity of a stroke is the standardized NIH Stroke Scale, developed by the NINDS. Health care professionals use the NIH Stroke Scale to measure a patient's neurological deficits by asking the patient to answer questions and to perform several physical and mental tests.

Imaging for the Diagnosis of Acute Stroke

Health care professionals also use a variety of imaging devices to evaluate stroke patients. The most widely used imaging procedure is the **computed tomography (CT) scan.** Also known as a CAT scan or computed axial tomography, CT creates a series of cross-sectional images of the head and brain. Because it is readily available at all hours at most major hospitals and produces
images quickly, CT is the most commonly used diagnostic technique for acute stroke. CT also has unique diagnostic benefits. It will quickly rule out a hemorrhage, can occasionally show a tumor that might mimic a stroke, and may even show evidence of early infarction. Infarctions generally show up on a CT scan about 6 to 8 hours after the start of stroke symptoms.

Another imaging device used for stroke patients is the *magnetic resonance imaging (MRI) scan*. MRI uses magnetic fields to detect subtle changes in brain tissue content. One effect of stroke is the slowing of water movement, called *diffusion*, through the damaged brain tissue. MRI can show this type of damage within the first hour after the stroke symptoms start. The benefit of MRI over a CT scan is more accurate and earlier diagnosis of infarction, especially for smaller strokes, while showing equivalent accuracy in determining when hemorrhage is present. MRI is more sensitive than CT for other types of brain disease, such as brain tumor, that might mimic a stroke. MRI cannot be performed in patients with certain types of metallic or electronic implants, such as pacemakers for the heart.

Other types of MRI scans, often used for the diagnosis of cerebrovascular disease and to predict the risk of stroke, are *magnetic resonance angiography (MRA)* and *functional magnetic resonance imaging (fMRI)*. Neurosurgeons use MRA to detect stenosis (blockage) of the brain arteries inside the skull by mapping flowing blood. Functional MRI uses a magnet to pick up signals from oxygenated blood and can show brain activity through increases in local blood flow.

*Duplex Doppler ultrasound* and *arteriography* are two diagnostic imaging techniques used to decide if an individual would benefit from a surgical procedure called *carotid endarterectomy*. This surgery is used to remove fatty deposits from the carotid arteries and can help prevent stroke.

Doppler ultrasound is a painless, noninvasive test in which sound waves above the range of human hearing are sent into the neck. Echoes bounce off the moving blood and the tissue in the artery and can be formed into an image. Ultrasound is fast, painless, risk-free, and relatively inexpensive compared to MRA and arteriography, but it is not considered to be as accurate as arteriography. Arteriography is an X-ray of the carotid artery taken when a special dye is injected into the artery.

**Who is at Risk for Stroke?**

Some people are at a higher risk for stroke than others. Unmodifiable risk factors include age, gender, race/ethnicity, and stroke family history. In contrast, other risk factors for stroke, like high blood pressure or cigarette smoking, can be changed or controlled by the person at risk.
Medications

Medication or drug therapy is the most common treatment for stroke. The most popular classes of drugs used to prevent or treat stroke are antithrombotics (antiplatelet agents and anticoagulants) and thrombolytics.

Antithrombotics prevent the formation of blood clots that can become lodged in a cerebral artery and cause strokes. Antiplatelet drugs prevent clotting by decreasing the activity of platelets, blood cells that contribute to the clotting property of blood. These drugs reduce the risk of blood-clot formation, thus reducing the risk of ischemic stroke. In the context of stroke, physicians prescribe antiplatelet drugs mainly for prevention. The most widely known and used antiplatelet drug is aspirin. Other antiplatelet drugs include clopidogrel, ticlopidine, and dipyridamole. The NINDS sponsors a wide range of clinical trials to determine the effectiveness of antiplatelet drugs for stroke prevention.

Anticoagulants reduce stroke risk by reducing the clotting property of the blood. The most commonly used anticoagulants include warfarin (also known as Coumadin®), heparin, and enoxaparin (also known as Lovenox). The NINDS has sponsored several trials to test the efficacy of anticoagulants versus antiplatelet drugs. The Stroke Prevention in Atrial Fibrillation (SPAF) trial found that, although aspirin is an effective therapy for the prevention of a second stroke in most patients with atrial fibrillation, some patients with additional risk factors do better on warfarin therapy.

Thrombolytic agents are used to treat an ongoing, acute ischemic stroke caused by an artery blockage. These drugs halt the stroke by dissolving the blood clot that is blocking blood flow to the brain. Recombinant tissue plasminogen activator (rt-PA) is a genetically engineered form of t-PA, a thrombolytic substance made naturally by the body. It can be effective if given intravenously within 3 hours of stroke symptom onset, but it should be used only after a physician has confirmed that the patient has suffered an ischemic stroke. Thrombolytic agents can increase bleeding and therefore must be used only after careful patient screening.

Surgery

Surgery can be used to prevent stroke, to treat acute stroke, or to repair vascular damage or malformations in and around the brain. There are two prominent types of surgery for stroke prevention and treatment: carotid endarterectomy and extracranial/intracranial (EC/IC) bypass.
Carotid endarterectomy is a surgical procedure in which a doctor removes fatty deposits (plaque) from the inside of one of the carotid arteries, which are located in the neck and are the main suppliers of blood to the brain. As mentioned earlier, the disease atherosclerosis is characterized by the buildup of plaque on the inside of large arteries, and the blockage of an artery by this fatty material is called stenosis.

One useful surgical procedure for treatment of brain aneurysms that cause subarachnoid hemorrhage is a technique called "clipping." Clipping involves clamping off the aneurysm from the blood vessel, which reduces the chance that it will burst and bleed.

## Post-Stroke Rehabilitation

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<tr>
<th>Type</th>
<th>Goal</th>
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<tbody>
<tr>
<td>Physical Therapy (PT)</td>
<td>Relearn walking, sitting, lying down, switching from one type of movement to another</td>
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<tr>
<td>Occupational Therapy (OT)</td>
<td>Relearn eating, drinking, dressing, bathing, cooking, reading, writing, toileting</td>
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<tr>
<td>Speech Therapy</td>
<td>Relearn language and communications skills, including swallowing.</td>
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<tr>
<td>Psychological/Psychiatric Therapy</td>
<td>Alleviate some mental and emotional problems</td>
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## What Disabilities Can Result From a Stroke?

Although stroke is a disease of the brain, it can affect the entire body. Some of the disabilities that can result from a stroke include paralysis, cognitive deficits, speech problems, emotional difficulties, daily living problems, and pain.

**Paralysis:**

A common disability that results from stroke is complete paralysis on one side of the body, called **hemiplegia.** A related disability that is not as debilitating as paralysis is one-sided
weakness or *hemiparesis*. The paralysis or weakness may affect only the face, an arm, or a leg or may affect one entire side of the body and face. A person who suffers a stroke in the left hemisphere of the brain will show right-sided paralysis or paresis. Conversely, a person with a stroke in the right hemisphere of the brain will show deficits on the left side of the body. A stroke patient may have problems with the simplest of daily activities, such as walking, dressing, eating, and using the bathroom. Motor deficits can result from damage to the motor cortex in the frontal lobes of the brain or from damage to the lower parts of the brain, such as the cerebellum, which controls balance and coordination. Some stroke patients also have trouble swallowing, called *dysphagia*.

*Cognitive deficits:*

Stroke may cause problems with thinking, awareness, attention, learning, judgment, and memory. In some cases of stroke, the patient suffers a "neglect" syndrome. The neglect means that a stroke patient has no knowledge of one side of his or her body, or one side of the visual field, or is unaware of the deficit. A stroke patient may be unaware of his or her surroundings, or may be unaware of the mental deficits that resulted from the stroke.

*Language deficits:*

Stroke victims often have problems understanding or forming speech. A deficit in understanding or forming speech is called *aphasia*. Aphasia usually occurs along with similar problems in reading or writing. In most people, language problems result from damage to the left hemisphere of the brain. Slurred speech due to weakness or incoordination of the muscles involved in speaking is called *dysarthria*, and is not a problem with language. Because it can result from any weakness or incoordination of the speech muscles, dysarthria can arise from damage to either side of the brain.

*Emotional deficits:*

A stroke can lead to emotional problems. Stroke patients may have difficulty controlling their emotions or may express inappropriate emotions in certain situations. One common disability that occurs with many stroke patients is depression. Post-stroke depression may be more than a general sadness resulting from the stroke incident. It is a clinical behavioral problem that can hamper recovery and rehabilitation and may even lead to suicide. Post-stroke depression is treated as any depression is treated, with antidepressant medications and therapy.

*Pain:*

Stroke patients may experience pain, uncomfortable numbness, or strange sensations after a stroke. These sensations may be due to many factors including damage to the sensory regions of the brain, stiff joints, or a disabled limb. An uncommon type of pain resulting from stroke is called *central stroke pain* or *central pain syndrome (CPS)*. CPS results from damage to an area in the mid-brain called the thalamus. The pain is a mixture of sensations, including heat and cold,
burning, tingling, numbness, and sharp stabbing and underlying aching pain. The pain is often worse in the extremities - the hands and feet - and is made worse by movement and temperature changes, especially cold temperatures. Unfortunately, since most pain medications provide little relief from these sensations, very few treatments or therapies exist to combat CPS.

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<th>Terms to know:</th>
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