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# WHAT IS A STROKE?

*From the Cerebrovascular Imaging and  
Intervention Committee of the American  
Heart Association Cardiovascular Council*

**Randall T. Higashida, M.D., Chair**



**American Stroke  
Association<sup>SM</sup>**

A Division of American  
Heart Association



THE NEURORADIOLOGY EDUCATION  
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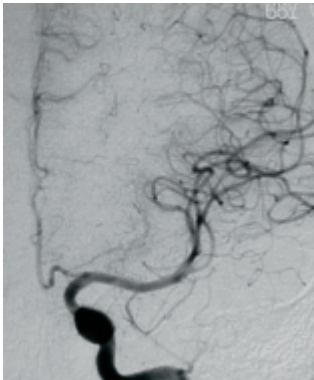
## What Is a Stroke?

**From the Cerebrovascular Imaging and Interventions Committee of the American Heart Association Cardiovascular Radiology Council**

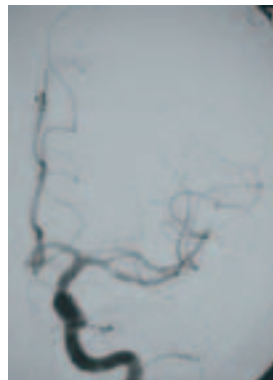
**Randall T. Higashida, M.D., Chair**

### **What is a stroke?**

An ischemic stroke is ANY damage to the brain caused by lack of blood flow in brain blood vessels or in major arteries leading to the brain. This usually results in temporary or permanent loss of one or more normal functions of the body. A hemorrhagic stroke is due to bleeding into the brain causing damage.



*This angiogram shows normal blood vessels to the brain.*



*In this angiogram, many normal blood vessels are not visible due to a blood clot blocking blood flow to the brain.*

### **How often do strokes occur?**

Strokes are very common. In the United States, someone suffers a stroke every 45 seconds. About 700,000 new and recurrent strokes occur each year. Strokes affect one in five people during their lifetime.

After heart disease and all forms of cancer, stroke is the third-leading cause of death in the United States, Canada, Europe and Japan.

## **What do strokes cost?**

Estimates are that strokes cost about \$50 billion a year in the United States. Over \$30 billion is spent on hospitalization, medical equipment and rehabilitation. (Strokes are a leading cause of adult disability, often requiring in-patient rehabilitation.) Lost productivity from stroke survivors being unable to return to their jobs accounts for nearly \$20 billion.

## **What factors increase the risk of stroke?**

There are two types of risk factors – those you can't control and those you can.

### **Factors you can't control:**

- **Age** — The older you are the higher your risk.
- **Gender** — Males are at higher risk than females.
- **Race** — Blacks, Hispanics/Latinos and Asians have higher risks than whites.
- **Family history of stroke and heart disease.**
- **A prior stroke or TIA (transient ischemic attack)**

### **Factors you can control:**

- **Diet** — Eat a diet low in saturated fat, cholesterol and salt.
- **Obesity** — The more overweight, the higher the risk.
- **High Blood Pressure** — Should be controlled and maintained at less than 140/90 mm Hg.
- **Heart Disease** — Atrial fibrillation (a rapid, irregular heartbeat) should be treated.
- **Carotid Artery Disease** — Can be treated by surgery, stenting or medical therapy
- **Smoking** — Should be avoided.
- **High Cholesterol** — Should be lowered.
- **Excess Alcohol Intake** — Should be avoided.
- **Diabetes** — Increases the risk for stroke and should be controlled through diet, oral hypoglycemics (drugs taken by mouth that lower blood sugar) or insulin.

## **What will happen if I have a stroke?**

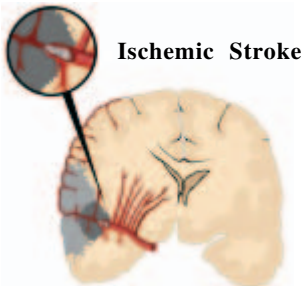
One of three things can happen:

- About 28 percent of strokes are fatal.
- Fifty to 70 percent of survivors will have a mild disability or will improve.
- Fifteen to 30 percent who survive will be severely disabled, even years after a stroke.
- Institutional care is required by 20 percent three months post-stroke.

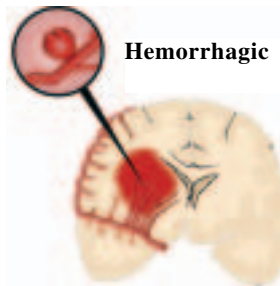
More than 4.6 million people in the United States have some disability from a stroke. Rehabilitation may benefit stroke survivors, but the underlying cause for the stroke still needs to be treated.

### **Are there different types of stroke?**

There are two major types of stroke. The first is caused by blocked blood flow and oxygen to the brain. This is called an “ischemic” stroke. They account for nearly 80 percent of all strokes. The second type is caused by bleeding into or around the brain. This is called a “hemorrhagic” stroke. Hemorrhagic strokes account for about 20 percent of strokes.



**Ischemic Stroke**

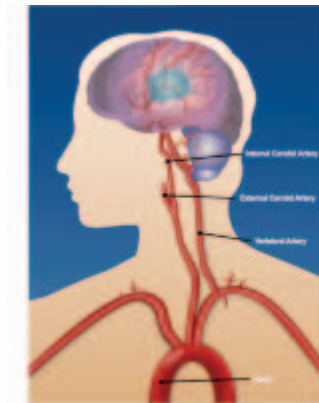


**Hemorrhagic Stroke**

### **What causes an ischemic stroke?**

An ischemic stroke is caused when blood flow is blocked either by a blood clot that forms in the heart or on a hardened fatty buildup (atherosclerotic plaque) in one of the larger blood vessels going to the brain. These vessels are the carotid artery in the front of the brain or the vertebral and basilar arteries in the back of the brain.

A blood clot that travels into the brain is called a “cerebral embolus.” A clot that builds up in the brain and ultimately blocks this blood vessel is called a “cerebral thrombosis.”



### **What causes a hemorrhagic stroke?**

A common cause is a ruptured “cerebral aneurysm.” This is a weakened section of a brain artery that has ballooned out and burst. Other causes are:

- A brain vascular malformation (commonly called an “arteriovenous malformation or AVM)
- High blood pressure that ruptures a tiny artery
- Drugs that cause acute blood pressure changes
- Direct brain injury

### **What is a transient ischemic attack (TIA)?**

A TIA occurs when a person briefly experiences stroke symptoms that last from several seconds to minutes, and then go away. There’s usually no permanent brain damage. However, a person experiencing a TIA should be examined immediately, because a TIA is often a sign that a major stroke will occur. Never ignore the warning signs of a stroke. A **TIA** is a very important warning sign!

### **What are the warning signs of a stroke?**

The most common warning signs of a stroke are:

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

### **What should a person do if they suspect they are having a stroke?**

The immediate response to experiencing or witnessing any of the symptoms outlined above is to call 9-1-1. The patient or their guardian should ask to be taken to the closest hospital or emergency room that **specializes in stroke treatment**. Staff at some hospitals may not be adequately prepared to recognize and treat stroke. **A person having a stroke needs to be evaluated quickly and treated before it is too late!**

### **What happens if a person ignores symptoms or delays treatment?**

The longer the delay for evaluation and treatment, the more likely the damage will be irreversible and permanent and the higher the chances of dying or experiencing severe disability from an acute stroke. Intravenous tPA (tissue Plasminogen Activator) is a FDA approved drug that improves the likelihood of partial or complete recovery for certain strokes. This drug can only be given to patients who qualify for this therapy and must be administered by properly trained personnel within 3 hours of the onset of certain strokes.

## What if a patient arrives after three hours from the start of a stroke?

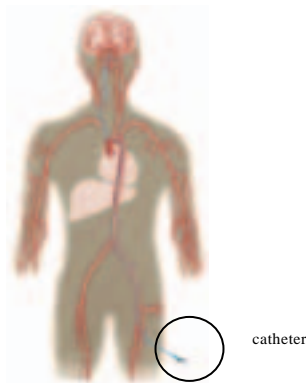
With a stroke, time is brain. The longer a person waits, the more likely the brain damage will be irreversible. Intravenous tPA (tissue Plasmingen Activator), the only FDA-approved drug treatment for acute, ischemic stroke, has not been shown to be effective after three hours. However, depending upon the severity of symptoms, a stroke patient may be eligible for other types of treatments. Evidence shows that placing a small tube (catheter) directly into the blood clot within the brain and giving a clot-dissolving drug within six hours may also improve outcome compared to no treatment. Depending upon a patient's overall medical condition and specific stroke type, they may be eligible for this treatment. These treatments are more specialized and require special facilities and physicians who are trained to perform these procedures.

Currently, a large number of clinical studies are looking at ways to improve the outcome of patients having a stroke. Most of these treatments, however, need to be started within six hours from stroke onset. This time factor makes it very important to seek medical attention as quickly as possible and at a hospital that specializes in stroke treatment.

## What tests are available to diagnose a stroke?

One or more of the following tests may be required to accurately diagnose a stroke:

- **Computed tomography (CT) brain scan.** This test involves taking a series of images of the brain to determine if bleeding may be a cause of the stroke. The brain tissue is also examined to see if irreversible brain damage has occurred. This test takes 15–20 minutes with only a slight amount of X-ray exposure. It is non-invasive and does not hurt.
- **Computed tomography angiogram (CTA).** This test is done in the CT scanner. Intravenous contrast (dye) is given and pictures are taken of the major blood vessels in and around the brain. This test is used to detect large blood vessels that may be blocked. It takes 15–20 minutes to perform and does not hurt.
- **Magnetic resonance imaging (MRI)/Magnetic resonance angiography (MRA).** These tests use the body's own magnetic properties to look at the brain tissue and the blood vessels. In some cases, an MRI can also be used to evaluate how much damage has already occurred to the brain tissue and brain function. This test takes 20–30 minutes to perform and does not hurt.
- **Cerebral angiogram.** This test involves guiding a small tube (catheter) from the leg blood vessels into the blood vessels of the neck and injecting a contrast material (dye) to see the blood flow. This lets a doctor see all the brain's large and small blood vessels. It is the most accurate test for directly looking at all of the brain's blood vessels to detect any blockages that may have caused a stroke. It is also used to determine if an aneurysm is present or if a blood vessel is abnormal. Although slightly more invasive, it is often required to accurately assessing whether there is an abnormality.



- **Lumbar puncture ( Spinal Tap).** This test involves placing a very small needle into the back and into the lumbar subarachnoid space and withdrawing a small amount of cerebrospinal fluid (CSF). It is the most accurate test to find out if a small amount of bleeding has occurred around the brain that may have resulted in a hemorrhagic stroke.
- **Ultrasound or "Doppler" scan.** This test involves placing a small transducer probe over the neck or forehead. Ultrasound waves are then used to look at the blood flow in the neck and the larger blood vessels of the brain. It does not hurt, and it allows rapid evaluation of the relative amount of blood flowing to the brain.
- **Nuclear medicine scan.** This test involves administering very small amounts of radioactive dye intravenously. The blood vessels and/or brain tissue are scanned to evaluate the relative amount of blood flowing to the brain and to look at brain function and activity.

### What treatments are available for ischemic strokes?

Ischemic strokes are caused by blood clots that block normal flow in brain blood vessels. If a person can be treated within three hours of their first symptoms, they benefit from intravenous tPA given to dissolve the blood clot. It has been shown that chances of complete recovery improve by 30 percent when the drug tPA is used soon enough on the correct types of stroke.

If a stroke is caused by an atherosclerotic plaque blocking a blood vessel, the patient may need a procedure to open up the vessel. If the blocked blood vessel is in the neck, they may need surgery (carotid endarterectomy) to open it.

However, if the blood vessel is not in an area suitable for surgery, a procedure called balloon angioplasty and stent placement may be more appropriate. This procedure



involves going inside the blood vessel with a small balloon, and inflating the balloon to open and dilate the blocked artery. In some cases, a small metallic tube called a “stent” is inserted to help keep the blood vessel open.

### **What treatments are available for hemorrhagic (bleeding) strokes?**

Many hemorrhagic strokes are caused by bleeding from a ruptured intracranial aneurysm. An aneurysm should be treated as quickly as possible, since there is a very high chance of repeated bleedings.



*Aneurysm that has not ruptured.*



*Ruptured aneurysm.*

More bleeding results in further brain injury or possibly death.

An aneurysm can be treated either by direct surgical clipping by a neurosurgeon or by treatment from inside the blood vessels (similar to an angiogram) by an interventional neuroradiologist.

Using X-ray guidance, the interventional neuroradiologist threads a small tube (catheter) through the brain blood vessels directly into the aneurysm. Very soft, tiny platinum coils can then be carefully placed into the aneurysm to prevent more bleeding. Depending upon the size and location of the aneurysm, and the patient’s condition, either surgical clipping or this endovascular coil treatment may be recommended.

Sometimes bleeding may be due to other causes, including an arteriovenous malformation. This occurs when, tiny abnormal blood vessels have become weakened and bursts. An angiogram is usually performed to identify the cause of bleeding into the brain.

### **What specialists are trained to evaluate stroke patients?**

Different kinds of specialists are available depending on the type of stroke being treated.

- **Emergency room doctor.** Specializes in the rapid evaluation of any and all types of medical emergencies. Patients should inform the emergency room doctor if they believe they may be having a stroke so the emergency room doctor can make a rapid and thorough assessment. If a patient arrives within three hours of when the stroke began, they could be eligible to receive a clot-dissolving drug. This drug has been shown to improve outcomes by 30 percent if it is given within the first three hours.
- **Stroke neurologist.** Specializes in evaluating and medically managing ischemic and hemorrhagic strokes. Has special training to recognize and treat strokes and to offer the most effective management of clot-dissolving drugs, blood pressure and other required medical therapies.
- **Neurosurgeon.** Specializes in surgically managing strokes. If a stroke is due to a ruptured aneurysm, vascular malformation or cerebral bleeding, surgery may be necessary to clip the aneurysm or remove a blood clot in the brain.
- **Vascular surgeon.** Specializes in surgically treating carotid artery disease due to atherosclerosis. If one of the major blood vessels to the brain, such as the carotid artery, is blocked, treating the blockage may require a procedure called “carotid endarterectomy.” This procedure involves opening up the blood vessel in the neck and surgically removing the atherosclerotic plaque to restore normal blood flow.
- **Interventional neuroradiologist/endovascular neurosurgeon.** Specializes in the interventional treatment of stroke using X-rays to see the damage and visualize treatment of the condition. If a stroke is due to a blood clot in the brain, it may be possible to place a small tube (catheter) directly into the clot and dissolve it or break it up to improve blood flow.

If the stroke is due to a blockage from plaque, it may be possible to open up the artery with balloon angioplasty to dilate the artery and possibly place a small metal tube called "stent" across the blockage to keep the blood vessel open.

If the stroke is due to an aneurysm or vascular malformation in the brain, it may be possible to treat the condition by placing small coils and other materials into the bleeding site to prevent more bleeding.

- **Diagnostic neuroradiologist.** Specializes in the rapid diagnostic evaluation of stroke and brain and spinal cord diseases. Special tests may be done to quickly and accurately diagnose the cause of a stroke, including computed tomography, magnetic resonance imaging, and diagnostic cerebral angiography. Has special expertise and training to rapidly perform these examinations, and diagnose the underlying condition.

### **Who performs the more-advanced stroke treatments?**

Interventional neuroradiologist/endovascular neurosurgeons perform these delicate operations in the brain to treat acute strokes. These doctors have had additional specialized training. That training is required in order to navigate within the delicate brain blood vessels to open up blocked arteries or close off weakened areas of blood vessels (aneurysms) that may have ruptured and bled.

Not every hospital has interventional neuroradiologists/endovascular neurosurgeons with these capabilities, so it is important that a patient who has stroke symptoms be taken to a facility that has these capabilities to maximize their chances for successful treatment.

*For more information, contact the American Stroke Association, a division of the American Heart Association, at 1-888-4-STROKE (1-888-478-7653) or visit [StrokeAssociation.org](http://StrokeAssociation.org).*

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