

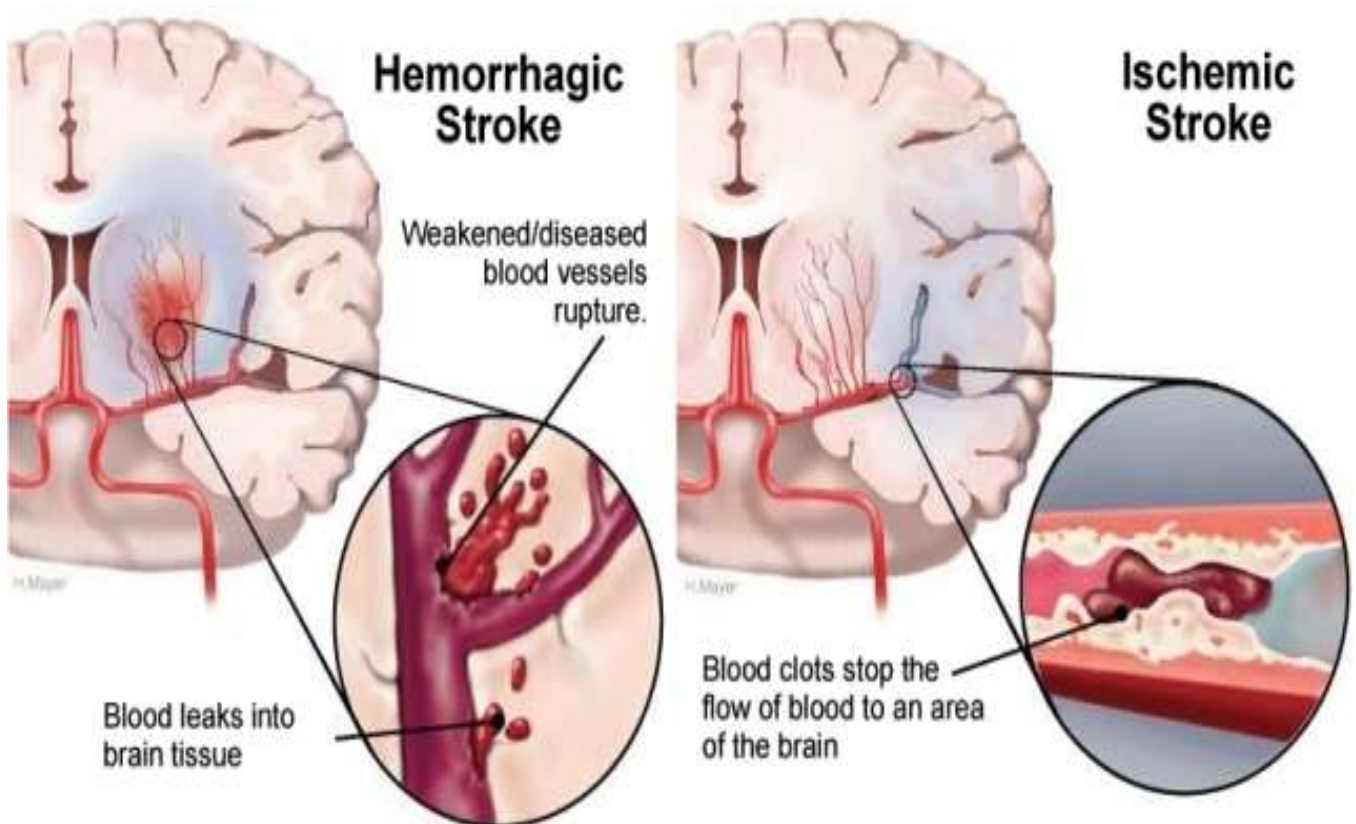
Stroke

Overview

A stroke occurs when the blood supply to part of your brain is interrupted or severely reduced, depriving brain tissue of oxygen and nutrients. Within minutes, brain cells begin to die.

A stroke is a medical emergency. Prompt treatment is crucial. Early action can minimize brain damage and potential complications.

The good news is that strokes can be treated and prevented, and many fewer Americans die of stroke now than even 15 years ago.



Symptoms and causes

Symptoms

Watch for these signs and symptoms if you think you or someone else may be having a stroke. Note when your signs and symptoms begin, because the length of time they have been present may guide your treatment decisions:

- **Trouble with speaking and understanding.** You may experience confusion. You may slur your words or have difficulty understanding speech.
- **Paralysis or numbness of the face, arm or leg.** You may develop sudden numbness, weakness or paralysis in your face, arm or leg, especially on one side of your body. Try to raise both your arms over your head at the same time. If one arm begins to fall, you may be having a stroke. Similarly, one side of your mouth may droop when you try to smile.
- **Trouble with seeing in one or both eyes.** You may suddenly have blurred or blackened vision in one or both eyes, or you may see double.
- **Headache.** A sudden, severe headache, which may be accompanied by vomiting, dizziness or altered consciousness, may indicate you're having a stroke.
- **Trouble with walking.** You may stumble or experience sudden dizziness, loss of balance or loss of coordination.

When to see a doctor

Seek immediate medical attention if you notice any signs or symptoms of a stroke, even if they seem to fluctuate or disappear.

Think "FAST" and do the following:

- **Face.** Ask the person to smile. Does one side of the face droop?
- **Arms.** Ask the person to raise both arms. Does one arm drift downward? Or is one arm unable to raise up?
- **Speech.** Ask the person to repeat a simple phrase. Is his or her speech slurred or strange?
- **Time.** If you observe any of these signs, call 911 immediately.

Call 911 or your local emergency number right away. Don't wait to see if symptoms go away. Every minute counts. The longer a stroke goes untreated, the greater the potential for brain damage and disability.

If you're with someone you suspect is having a stroke, watch the person carefully while waiting for emergency assistance.

Causes

A stroke occurs when the blood supply to your brain is interrupted or reduced. This deprives your brain of oxygen and nutrients, which can cause your brain cells to die.

A stroke may be caused by a blocked artery (ischemic stroke) or the leaking or bursting of a blood vessel (hemorrhagic stroke). Some people may experience only a temporary disruption of blood flow to their brain (transient ischemic attack, or TIA).

Ischemic stroke

About 85 percent of strokes are ischemic strokes. Ischemic strokes occur when the arteries to your brain become narrowed or blocked, causing severely reduced blood flow (ischemia). The most common ischemic strokes include:

- **Thrombotic stroke.** A thrombotic stroke occurs when a blood clot (thrombus) forms in one of the arteries that supply blood to your brain. A clot may be caused by fatty deposits (plaque) that build up in arteries and cause reduced blood flow (atherosclerosis) or other artery conditions.
- **Embolic stroke.** An embolic stroke occurs when a blood clot or other debris forms away from your brain — commonly in your heart — and is swept through your bloodstream to lodge in narrower brain arteries. This type of blood clot is called an embolus.

Hemorrhagic stroke

Hemorrhagic stroke occurs when a blood vessel in your brain leaks or ruptures. Brain hemorrhages can result from many conditions that affect your blood vessels, including uncontrolled high blood pressure (hypertension), overtreatment with anticoagulants and weak spots in your blood vessel walls (aneurysms).

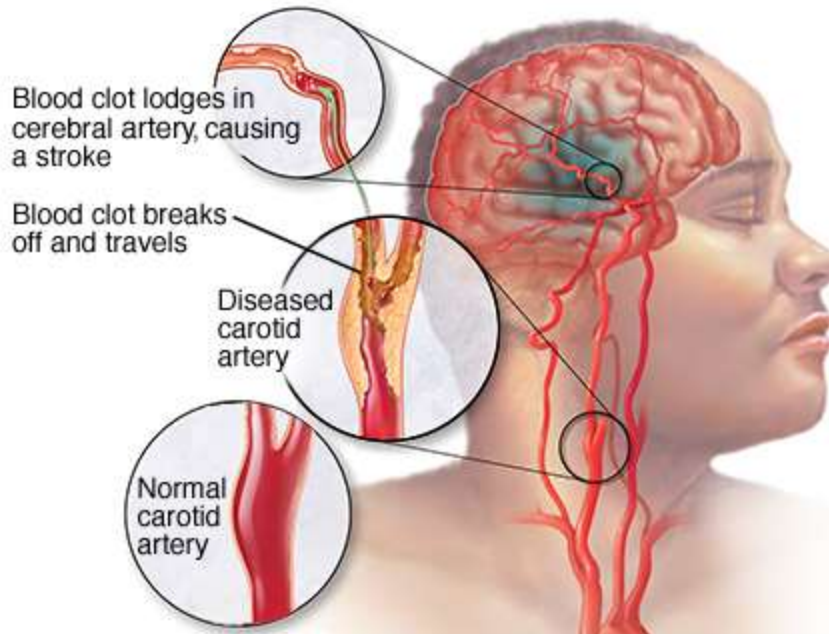
A less common cause of hemorrhage is the rupture of an abnormal tangle of thin-walled blood vessels (arteriovenous malformation) present at birth. Types of hemorrhagic stroke include:

- **Intracerebral hemorrhage.** In an intracerebral hemorrhage, a blood vessel in the brain bursts and spills into the surrounding brain tissue, damaging brain cells. Brain cells beyond the leak are deprived of blood and also damaged.

High blood pressure, trauma, vascular malformations, use of blood-thinning medications and other conditions may cause an intracerebral hemorrhage.

- **Subarachnoid hemorrhage.** In a subarachnoid hemorrhage, an artery on or near the surface of your brain bursts and spills into the space between the surface of your brain and your skull. This bleeding is often signaled by a sudden, severe headache.

A subarachnoid hemorrhage is commonly caused by the bursting of a small sack-shaped or berry-shaped outpouching on an artery known as an aneurysm. After the hemorrhage, the blood vessels in your brain may widen and narrow erratically (vasospasm), causing brain cell damage by further limiting blood flow.



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Ischemic stroke

Ischemic stroke occurs when a blood clot blocks or plugs an artery leading to the brain. A blood clot often forms in arteries damaged by the buildup of plaques (atherosclerosis). It can occur in the carotid artery of the neck as well as other arteries.

Transient ischemic attack (TIA)

A transient ischemic attack (TIA) — also known as a ministroke — is a brief period of symptoms similar to those you'd have in a stroke. A temporary decrease in blood supply to part of your brain causes TIAs, which often last less than five minutes.

Like an ischemic stroke, a TIA occurs when a clot or debris blocks blood flow to part of your brain. A TIA doesn't leave lasting symptoms because the blockage is temporary.

Seek emergency care even if your symptoms seem to clear up. Having a TIA puts you at greater risk of having a full-blown stroke, causing permanent damage later. If you've had a TIA, it means there's likely a partially blocked or narrowed artery leading to your brain or a clot source in the heart.

It's not possible to tell if you're having a stroke or a TIA based only on your symptoms. Up to half of people whose symptoms appear to go away actually have had a stroke causing brain damage.

Complications

A stroke can sometimes cause temporary or permanent disabilities, depending on how long the brain lacks blood flow and which part was affected. Complications may include:

- **Paralysis or loss of muscle movement.** You may become paralyzed on one side of your body, or lose control of certain muscles, such as those on one side of your face or one arm. Physical therapy may help you return to activities hampered by paralysis, such as walking, eating and dressing.
- **Difficulty talking or swallowing.** A stroke may cause you to have less control over the way the muscles in your mouth and throat move, making it difficult for you to talk clearly (dysarthria), swallow or eat (dysphagia). You also may have difficulty with language (aphasia), including speaking or understanding speech, reading or writing. Therapy with a speech and language pathologist may help.
- **Memory loss or thinking difficulties.** Many people who have had strokes experience some memory loss. Others may have difficulty thinking, making judgments, reasoning and understanding concepts.
- **Emotional problems.** People who have had strokes may have more difficulty controlling their emotions, or they may develop depression.
- **Pain.** People who have had strokes may have pain, numbness or other strange sensations in parts of their bodies affected by stroke. For example, if a stroke causes you to lose feeling in your left arm, you may develop an uncomfortable tingling sensation in that arm.

People also may be sensitive to temperature changes, especially extreme cold after a stroke. This complication is known as central stroke pain or central pain syndrome. This condition generally develops several weeks after a stroke, and it may improve over time. But because the pain is caused by a problem in your brain, rather than a physical injury, there are few treatments.

- **Changes in behavior and self-care ability.** People who have had strokes may become more withdrawn and less social or more impulsive. They may need help with grooming and daily chores.

As with any brain injury, the success of treating these complications will vary from person to person.

Treatment

Emergency treatment for stroke depends on whether you're having an ischemic stroke blocking an artery — the most common kind — or a hemorrhagic stroke that involves bleeding into the brain.

Ischemic stroke

To treat an ischemic stroke, doctors must quickly restore blood flow to your brain.

Emergency treatment with medications. Therapy with clot-busting drugs must start within 3 hours if they are given into the vein — and the sooner, the better. Quick treatment not only improves your chances of survival but also may reduce complications. You may be given:

- **Aspirin.** Aspirin is an immediate treatment given in the emergency room to reduce the likelihood of having another stroke. Aspirin prevents blood clots from forming.
- **Intravenous injection of tissue plasminogen activator (TPA).** Some people can benefit from an injection of a recombinant tissue plasminogen activator (TPA), also called alteplase. An injection of TPA is usually given through a vein in the arm. This potent clot-busting drug needs to be given within 4.5 hours after stroke symptoms begin if it's given in the vein.

TPA restores blood flow by dissolving the blood clot causing your stroke, and it may help people who have had strokes recover more fully. Your doctor will consider certain risks, such as potential bleeding in the brain, to determine if TPA is appropriate for you.

Emergency procedures. Doctors sometimes treat ischemic strokes with procedures that must be performed as soon as possible, depending on features of the blood clot:

- **Medications delivered directly to the brain.** Doctors may insert a long, thin tube (catheter) through an artery in your groin and thread it to your brain to deliver TPA directly into the area where the stroke is occurring. The time window for this treatment is somewhat longer than for intravenous TPA but is still limited.
- **Mechanical clot removal.** Doctors may use a catheter to maneuver a tiny device into your brain to physically break up or grab and remove the clot.

However, recent studies suggest that for most people, delivering medication directly to the brain (intra-arterial thrombolysis) or using a device to break up or remove clots (mechanical thrombectomy) may not be beneficial. Researchers are working to determine who might benefit from this procedure.

Other procedures. To decrease your risk of having another stroke or transient ischemic attack, your doctor may recommend a procedure to open up an artery that's narrowed by fatty deposits (plaques). Doctors sometimes recommend the following procedures to prevent a stroke. Options will vary depending on your situation:

- **Carotid endarterectomy.** In a carotid endarterectomy, a surgeon removes plaques from arteries that run along each side of your neck to your brain (carotid arteries). In this procedure, your surgeon makes an incision along the front of your neck, opens your carotid artery and removes plaques that block the carotid artery.

Your surgeon then repairs the artery with stitches or a patch made from a vein or artificial material (graft). The procedure may reduce your risk of ischemic stroke. However, a carotid endarterectomy also involves risks, especially for people with heart disease or other medical conditions.

- **Angioplasty and stents.** In an angioplasty, a surgeon gains access to your carotid arteries most often through an artery in your groin. Here, he or she can gently and safely navigate to the carotid arteries in your neck. A balloon is then used to expand the narrowed artery. Then a stent can be inserted to support the opened artery.

Hemorrhagic stroke

Emergency treatment of hemorrhagic stroke focuses on controlling your bleeding and reducing pressure in your brain. Surgery also may be performed to help reduce future risk.

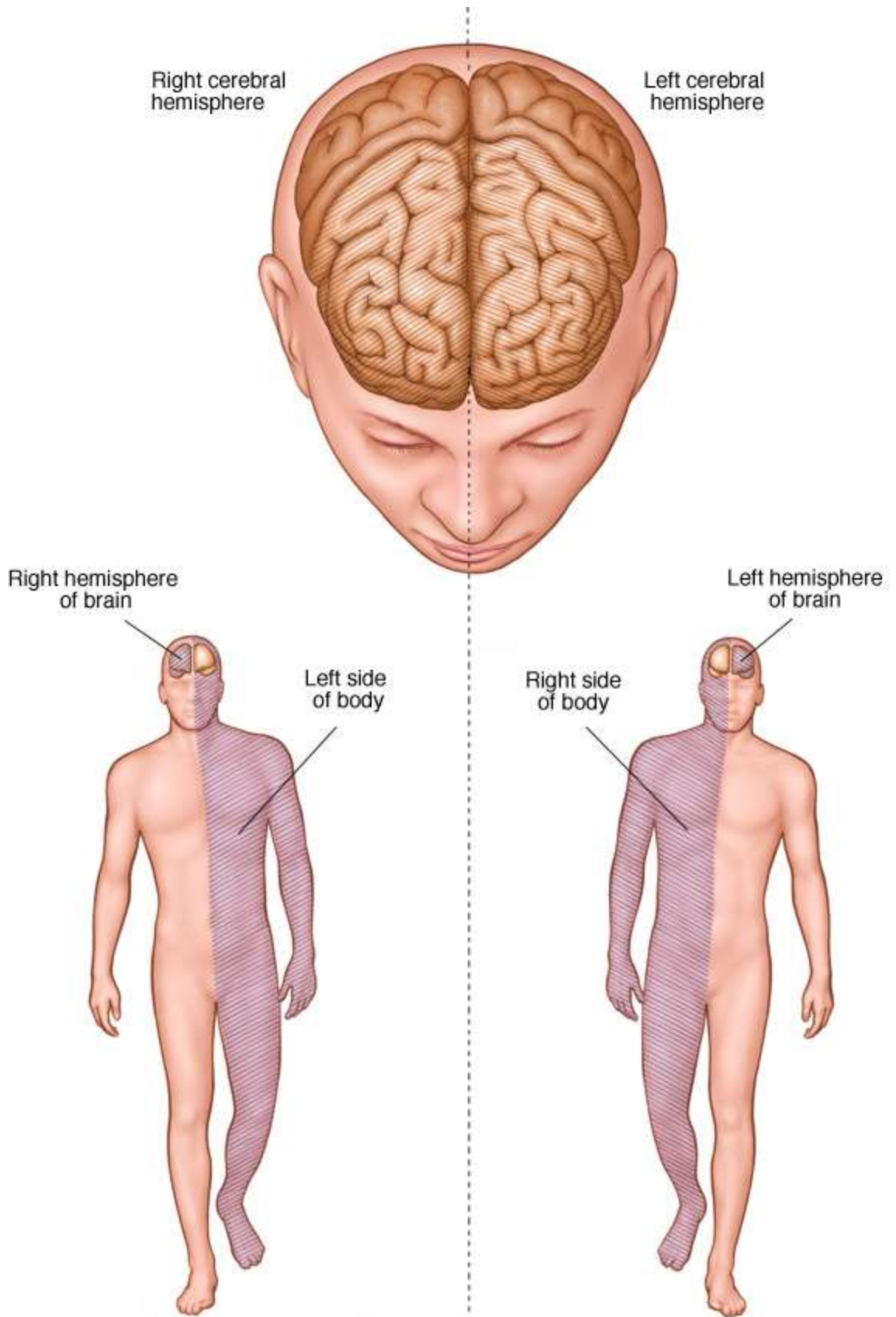
Emergency measures. If you take warfarin (Coumadin) or anti-platelet drugs such as clopidogrel (Plavix) to prevent blood clots, you may be given drugs or transfusions of blood products to counteract the blood thinners' effects. You may also be given drugs to lower pressure in your brain (intracranial pressure), lower your blood pressure, prevent vasospasm or prevent seizures.

Once the bleeding in your brain stops, treatment usually involves supportive medical care while your body absorbs the blood. Healing is similar to what happens while a bad bruise goes away. If the area of bleeding is large, your doctor may perform surgery to remove the blood and relieve pressure on your brain.

Surgical blood vessel repair. Surgery may be used to repair blood vessel abnormalities associated with hemorrhagic strokes. Your doctor may recommend one of these procedures after a stroke or if an aneurysm or arteriovenous malformation (AVM) or other type of vascular malformation caused your hemorrhagic stroke:

- **Surgical clipping.** A surgeon places a tiny clamp at the base of the aneurysm, to stop blood flow to it. This clamp can keep the aneurysm from bursting, or it can prevent re-bleeding of an aneurysm that has recently hemorrhaged.
- **Coiling (endovascular embolization).** In this procedure, a surgeon inserts a catheter into an artery in your groin and guides it to your brain using X-ray imaging. Your surgeon then guides tiny detachable coils into the aneurysm (aneurysm coiling). The coils fill the aneurysm, which blocks blood flow into the aneurysm and causes the blood to clot.
- **Surgical AVM removal.** Surgeons may remove a smaller AVM if it's located in an accessible area of your brain, to eliminate the risk of rupture and lower the risk of hemorrhagic stroke. However, it's not always possible to remove an AVM if its removal would cause too large a reduction in brain function, or if it's large or located deep within your brain.
- **Intracranial bypass.** In some unique circumstances, surgical bypass of intracranial blood vessels may be an option to treat poor blood flow to a region of the brain or complex vascular lesions, such as aneurysm repair.
- **Stereotactic radiosurgery.** Using multiple beams of highly focused radiation, stereotactic radiosurgery is an advanced minimally invasive treatment used to repair vascular malformations.

Stroke recovery and rehabilitation



Brain hemisphere connections

Brain hemisphere connections

Following emergency treatment, stroke care focuses on helping you regain your strength, recover as much function as possible and return to independent living. The impact of your stroke depends on the area of the brain involved and the amount of tissue damaged.

If your stroke affected the right side of your brain, your movement and sensation on the left side of your body may be affected. If your stroke damaged the brain tissue on the left side of your brain, your movement and sensation on the right side of your body may be affected. Brain damage to the left side of your brain may cause speech and language disorders.

In addition, if you've had a stroke, you may have problems with breathing, swallowing, balancing and vision.

Most stroke survivors receive treatment in a rehabilitation program. Your doctor will recommend the most rigorous therapy program you can handle based on your age, overall health and your degree of disability from your stroke. Your doctor will take into consideration your lifestyle, interests and priorities, and the availability of family members or other caregivers.

Your rehabilitation program may begin before you leave the hospital. It may continue in a rehabilitation unit of the same hospital, another rehabilitation unit or skilled nursing facility, an outpatient unit, or your home.

Every person's stroke recovery is different. Depending on your condition, your treatment team may include:



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Speech therapy session Speech therapy session

- Doctor trained in brain conditions (neurologist)
- Rehabilitation doctor (physiatrist)
- Nurse
- Dietitian
- Physical therapist
- Occupational therapist
- Recreational therapist
- Speech therapist
- Social worker
- Case manager
- Psychologist or psychiatrist
- Chaplain

Prevention

Knowing your stroke risk factors, following your doctor's recommendations and adopting a healthy lifestyle are the best steps you can take to prevent a stroke. If you've had a stroke or a transient ischemic attack (TIA), these measures may help you avoid having another stroke. The follow-up care you receive in the hospital and afterward may play a role as well.

Many stroke prevention strategies are the same as strategies to prevent heart disease. In general, healthy lifestyle recommendations include:

- **Controlling high blood pressure (hypertension).** One of the most important things you can do to reduce your stroke risk is to keep your blood pressure under control. If you've had a stroke, lowering your blood pressure can help prevent a subsequent transient ischemic attack or stroke.

Exercising, managing stress, maintaining a healthy weight, and limiting the amount of sodium and alcohol you eat and drink are all ways to keep high blood pressure in check.. In addition to recommending lifestyle changes, your doctor may prescribe medications to treat high blood pressure.

- **Lowering the amount of cholesterol and saturated fat in your diet.** Eating less cholesterol and fat, especially saturated fat and trans fats, may reduce the fatty deposits (plaques) in your arteries. If you can't control your cholesterol through dietary changes alone, your doctor may prescribe a cholesterol-lowering medication.
- **Quitting tobacco use.** Smoking raises the risk of stroke for smokers and nonsmokers exposed to secondhand smoke. Quitting tobacco use reduces your risk of stroke.
- **Controlling diabetes.** You can manage diabetes with diet, exercise, weight control and medication.
- **Maintaining a healthy weight.** Being overweight contributes to other stroke risk factors, such as high blood pressure, cardiovascular disease and diabetes. Weight loss of as little as 10 pounds may lower your blood pressure and improve your cholesterol levels.
- **Eating a diet rich in fruits and vegetables.** A diet containing five or more daily servings of fruits or vegetables may reduce your risk of stroke. Following the Mediterranean diet, which emphasizes olive oil, fruit, nuts, vegetables and whole grains, may be helpful.
- **Exercising regularly.** Aerobic or "cardio" exercise reduces your risk of stroke in many ways. Exercise can lower your blood pressure, increase your level of high-density lipoprotein cholesterol, and improve the overall health of your blood vessels and heart. It also helps you lose weight, control diabetes and reduce stress. Gradually work up to 30 minutes of activity — such as walking, jogging, swimming or bicycling — on most, if not all, days of the week.
- **Drinking alcohol in moderation, if at all.** Alcohol can be both a risk factor and a protective measure for stroke. Heavy alcohol consumption increases your risk of high blood pressure, ischemic strokes and hemorrhagic strokes. However, drinking small to moderate amounts of alcohol, such as one drink a day, may help prevent ischemic stroke and decrease your blood's clotting tendency. Alcohol may also interact with other drugs you're taking. Talk to your doctor about what's appropriate for you.
- **Treating obstructive sleep apnea, if present.** Your doctor may recommend an overnight oxygen assessment to screen for obstructive sleep apnea (OSA). If OSA is detected, it may be treated by giving you oxygen at night or having you wear a small device in your mouth.

- **Avoiding illicit drugs.** Certain street drugs, such as cocaine and methamphetamines, are established risk factors for a TIA or a stroke. Cocaine reduces blood flow and can cause narrowing of arteries.

Preventive medications

If you've had an ischemic stroke or TIA, your doctor may recommend medications to help reduce your risk of having another stroke. These include:

- **Anti-platelet drugs.** Platelets are cells in your blood that initiate clots. Anti-platelet drugs make these cells less sticky and less likely to clot. The most commonly used anti-platelet medication is aspirin. Your doctor can help you determine the right dose of aspirin for you.

Your doctor may also consider prescribing Aggrenox, a combination of low-dose aspirin and the anti-platelet drug dipyridamole, to reduce the risk of blood clotting. If aspirin doesn't prevent your TIA or stroke, or if you can't take aspirin, your doctor may instead prescribe an anti-platelet drug such as clopidogrel (Plavix).

- **Anticoagulants.** These drugs, which include heparin and warfarin (Coumadin), reduce blood clotting. Heparin is fast-acting and may be used over a short period of time in the hospital. Slower acting warfarin may be used over a longer term.

Warfarin is a powerful blood-thinning drug, so you'll need to take it exactly as directed and watch for side effects. Your doctor may prescribe these drugs if you have certain blood-clotting disorders, certain arterial abnormalities, an abnormal heart rhythm or other heart problems. Other newer blood thinners may be used if your TIA or stroke was caused by an abnormal heart rhythm.