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Special Report

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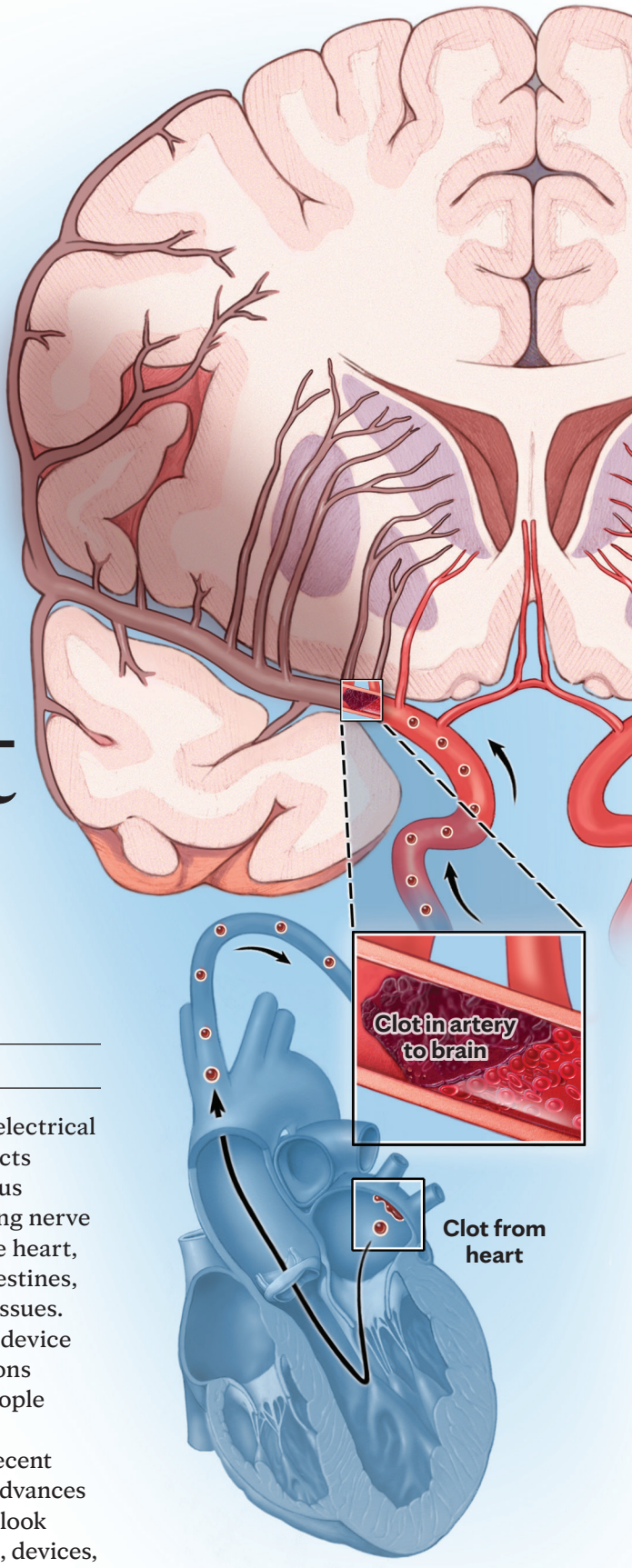


An ischemic stroke can occur when a tiny blood clot or other material breaks loose from an artery outside the brain — or from within the heart. Then the clot can be swept through larger arteries into smaller vessels in the brain, blocking blood flow.

A new future after stroke

Recent advances save lives and restore function

Ten years after her stroke, Contessa Siders, 43, still couldn't use her right hand or arm. Because her fingers remained limp, activities that required both hands — cutting food, lifting, folding laundry — were challenging.

With the help of her rehabilitation exercises, Siders noticed minor improvements occasionally. However, given the amount of time that had passed since her stroke, the South Dakota mother accepted that she'd probably reached her new normal.

Then in 2021, the Food and Drug Administration (FDA) approved a new therapy — called a vagus nerve stimulation (VNS) device — for stroke survivors of all ages who, like Siders, continue to experience weakness, stiffness, and limited mobility in an arm or hand. Originally developed to treat epilepsy, the implanted device looks and functions like a pacemaker. However, instead of sending electrical signals to the heart, VNS directs electrical impulses to the vagus nerve. This foot-and-a-half-long nerve connects the brainstem to the heart, lungs, stomach, pancreas, intestines, and many other organs and tissues. By stimulating the nerve, the device can jump-start new connections among brain cells, helping people regain function.

The device is one of many recent treatment and rehabilitation advances that have transformed the outlook after stroke. New medications, devices, surgical equipment and treatment protocols are helping to save more lives than ever before — and to reduce the severity of stroke-related disability.

"We are in the dawn of an exciting era in stroke recovery," says Zafer Keser, M.D., a vascular neurologist at Mayo Clinic in Rochester, Minnesota.

"So many devices and technologies are nearing approvals or in the pipeline. Ultimately, the damage that happens to the brain is permanent. That doesn't go away. But our therapy options are rapidly expanding, and there is more and more hope as the months and years go by."

The power of neuroplasticity

Also called a "brain attack," a stroke takes place when an artery carrying blood to the brain either becomes clogged or ruptures. This deprives brain cells, called neurons, of the oxygen and nutrients they need.

The brain is composed of billions of neurons — nerve cells that collect, process and send information — as well as a complex network of electrical circuits that allow these cells to communicate. Once a stroke starts, the brain can lose about 1.9 million of these important cells each minute. For every hour without treatment, the brain loses as many cells as it naturally does in nearly 3.6 years.

This loss of brain cells can affect the brain's ability to communicate with muscles and sensory organs, leading to disability and, in some cases, death. For example, someone might experience any of the following after a stroke:

- Difficulty with speech.
- Swallowing problems.
- Memory loss.
- Reduced or double vision.
- Difficulty understanding others.
- Weakness in the face, arm or leg.
- Numbness or loss of feeling in the face, arm or leg.
- Unsteady standing and walking.
- Lack of coordination.
- Headaches.

It was once thought that many of these changes were permanent. Once a stroke damaged the brain, it was assumed that the brain would remain forever altered and never recover. However, neuroscientists now view the brain as having plasticity, meaning it can form new neural connections and reorganize in response to injury. When cells in one area of the brain die, for example, the brain can build new connections to other healthy neurons.

This neural reorganization functions like a detour you might follow when construction has closed the highway. This alternate route might be less familiar, require more effort to navigate and lengthen your travel time. However, the detour will eventually take you to your chosen destination — and if you continue to travel the same route on future trips, your familiarity will grow.

Types of stroke

Every 40 seconds, someone in the U.S. has a stroke, according to the Centers for Disease Control and Prevention.

Sometimes, strokes occur in areas of the brain that aren't heavily involved in talking, walking and other daily tasks. As a result, strokes may initially cause no noticeable symptoms and may be picked up only during brain imaging. But over time, these repeated silent strokes can lead to cognitive issues such as memory lapses. Other strokes trigger noticeable symptoms and can cause significant brain damage or death if left untreated.

There are two main types of stroke.

Ischemic stroke

This is the most common type of stroke. It occurs when a blood vessel in the brain becomes narrowed or blocked by fatty deposits, a blood clot (thrombus) or other debris. Once lodged in a blood vessel, the substance obstructs blood flow. The amount of brain tissue affected depends on where the blockage occurs. If a tiny blood vessel is blocked, it will interrupt blood flow to smaller areas of brain tissue than if a larger vessel is blocked. If not addressed, an ischemic stroke can lead to death or long-term disability.

There are several different types of ischemic stroke:

- *Thrombotic* — A blood clot can form on a preexisting partial blockage, called a plaque, and block blood flow to the brain. Plaque is a buildup of hardened cholesterol and other substances in the lining of the artery.
- *Embolic* — A tiny blood clot or other material such as fat, air or debris may break loose from an artery outside the brain — or from the heart. Then it can be swept through larger arteries into smaller vessels in the brain. An embolic stroke happens when the clot lodges in a brain artery, blocking blood flow.
- *Lacunar* — This type of stroke occurs when the smallest arteries deep within the brain become blocked. This stroke type usually is less severe than others.

Hemorrhagic stroke

This type of stroke occurs when an artery in the brain leaks or ruptures. In addition to depriving brain cells of oxygen, a hemorrhage causes blood to pool. This puts pressure on surrounding tissue and can cause further damage. Factors related to hemorrhagic stroke include:

GET TREATMENT, EVEN IF SYMPTOMS RESOLVE

Some strokelike events can resolve on their own. Sometimes referred to as "ministrokes," these transient ischemic attacks (TIAs) stem from a short-term interruption of blood flow to part of the brain.

Most TIAs last less than 20 minutes. Even though a TIA doesn't lead to permanent brain damage, it still requires immediate medical attention.

A TIA is a warning sign of future stroke risk. People who've had a TIA are five times more likely to experience a future stroke than people who've never had a TIA. And 1 in 3 people who've had a TIA goes on to experience a stroke. After the underlying cause of the TIA is determined, medication, surgery or lifestyle changes may be recommended to reduce the risk of having a fatal or disabling stroke.

- Uncontrolled high blood pressure.
- Treatment with anti-clotting drugs, called anticoagulants.
- Bulges at weak spots in the blood vessel walls, known as aneurysms.
- Head trauma, such as from a fall or car accident.
- Protein deposits in blood vessel walls that lead to weakness in the vessel walls. This is known as cerebral amyloid angiopathy.
- Inflammation involving the blood vessel walls, called vasculitis.
- An ischemic stroke that bleeds.
- A condition present at birth called arteriovenous malformation (AVM).

Stroke prevention

A stroke can happen at any point in life, including in a younger adult like Siders. However, the risk rises with age, doubling every decade after age 55. Optimizing healthy lifestyle habits can lower the risk.

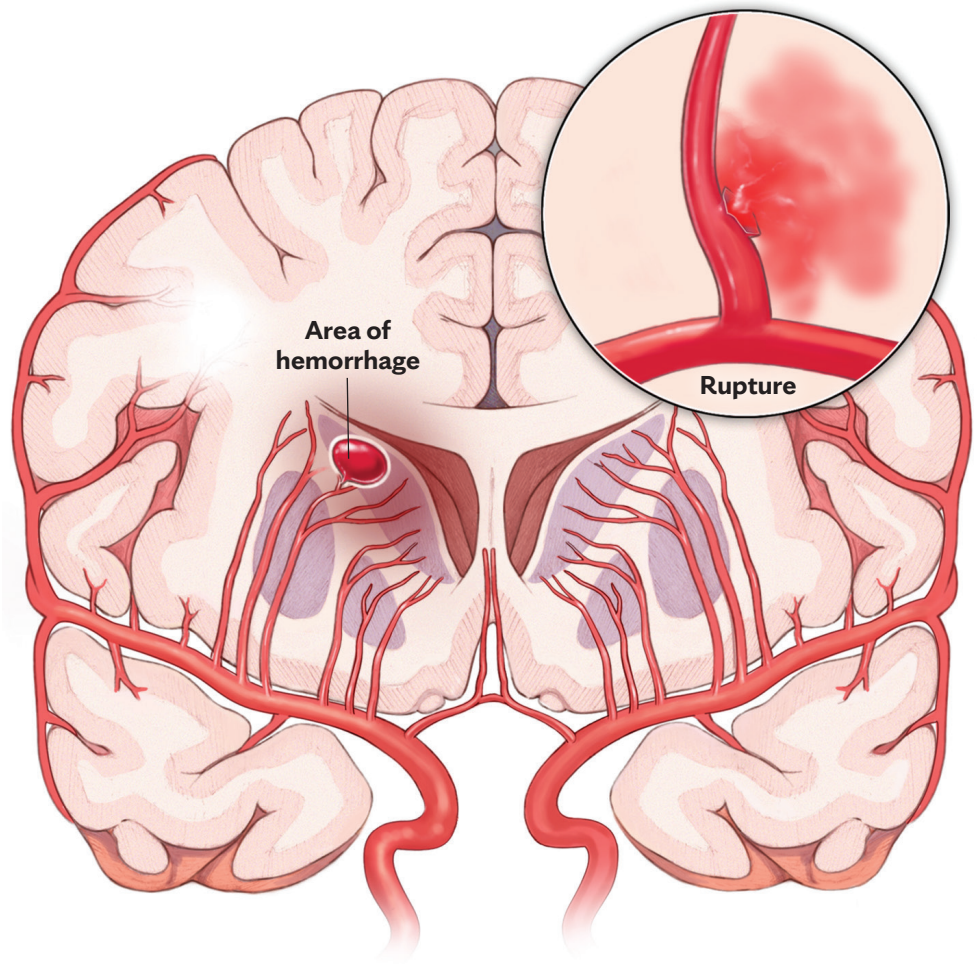
Protecting your brain from a stroke is no different from protecting your heart from a heart attack. You can follow a lifestyle that protects blood vessels throughout your body from damage. That includes getting treated for heart rhythm conditions such as atrial fibrillation, obstructive sleep apnea, diabetes, obesity, sickle cell anemia and other health conditions that raise stroke risk. See "Know your numbers" on page 4 for health indicators that can help you and your healthcare team keep track of your stroke risks.

The Nurses' Health Study and the Health Professionals Follow-Up Study followed more than 71,000 women and 43,000 men over several decades. These large, long-term studies identified five lifestyle components that reduce the risk of stroke by up to 80%.

Exercise consistently

Regular exercise reduces stroke risk by strengthening the heart, improving circulation, and improving blood pressure and cholesterol levels. It also can help with weight management.

To get regular cardiovascular exercise, aim for at least 150 minutes of moderate aerobic activity a week.



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WHAT IS AN ANEURYSM?

An aneurysm starts when a weak spot in an artery wall becomes thin and stretched. Eventually, the stretching leads to a saclike pouch that looks like a berry hanging on a stem.

If the pouch ruptures, blood seeps out of the artery and into areas of the brain where it doesn't belong. A ruptured aneurysm quickly becomes life-threatening and requires medical treatment right away.

Most often, a ruptured brain aneurysm occurs in the space between the brain and the thin tissues covering the brain. This type of hemorrhagic stroke is called a subarachnoid hemorrhage.

Brain aneurysms are common. But most brain aneurysms aren't serious and won't rupture, especially if they're small. These small aneurysms usually don't cause symptoms or health concerns. In many cases, they're only discovered during tests for other conditions.

If a brain aneurysm hasn't ruptured, treatment may be appropriate. Treatment of an unruptured brain aneurysm reduces your risk of a future rupture. Talk with your healthcare team about the best options for your specific needs.

KNOW YOUR NUMBERS

To prevent stroke, pay attention to the results of routine medical tests. If any of the following health indicators are outside of the healthy range, talk to your healthcare team about potential lifestyle changes, medications and treatments that may help.

Health indicator	Healthy range
Blood pressure	Less than 120/80 millimeters of mercury (mm Hg)
Fasting blood glucose	Less than 100 milligrams per deciliter (mg/dL)
Hemoglobin A1C	Less than 6.5%
Total cholesterol	Less than 200 mg/dL
Triglycerides	Less than 150 mg/dL
HDL cholesterol	Above 45 mg/dL (men) and 55 mg/dL (women)
LDL cholesterol	Less than 130 mg/dL
LDL to HDL ratio	Less than 4.0
Waist circumference	Less than 40 inches (men) and 35 inches (women)

PREVENTING STROKE WITH MEDICINE

In addition to changing your lifestyle, consider talking to your care team about preventive medications. Antiplatelet drugs, such as aspirin, clopidogrel (Plavix) or ticagrelor (Brilinta), can make your blood less likely to form clots. Anticoagulants, such as apixaban, rivaroxaban, dabigatran or warfarin, can help prevent strokes if you have certain heart conditions or a blood-clotting disorder.

Walking, biking, swimming and other activities that raise the heart rate are effective. In addition, do resistance exercises that strengthen muscles throughout your body twice a week.

If you already have had a stroke or if you have limited mobility, talk with your healthcare team about exercise modifications to help you remain active.

Follow a plant-based, whole foods diet

In the Nurses' Health and Health Professionals Follow-Up studies, people who ate more vegetables, fruit, nuts, soy and other plant foods were less likely to experience strokes than were those who consumed fewer plants and more unhealthy fats. Other research has linked plant-based eating patterns — such as what's found with the Mediterranean diet, the Mayo Clinic Diet and the Dietary Approaches to Stop Hypertension (DASH) eating plan — with a lower risk of stroke. These eating patterns are relatively low in sodium, added sugar and fat from animal products.

Specifically, aim for at least five daily servings of fruits and vegetables. Besides being low in calories and rich in dietary fiber, fruits and vegetables contain essential vitamins and minerals. In addition, consume healthy fats from fish, avocados, olives and olive oil, and nuts and seeds instead of the saturated and hydrogenated fats from animal products and ultra-processed foods. Also, be aware of salt. Too much sodium can worsen blood pressure.

Maintain a healthy weight

Being overweight increases your chance of developing high blood pressure, heart disease and diabetes. All of these raise your risk of stroke. If healthy eating and exercise don't bring your weight into a healthy range, consider getting more support. You might, for example, consult with a dietitian or nutritionist, attend healthy-eating classes, or join a weight-loss program. If you've tried all these measures without success, talk with your healthcare team about weight-loss medications and treatments.

Recent evidence suggests that two classes of drugs used for diabetes and weight loss — GLP-1 receptor agonists such as semaglutide and tirzepatide and SGLT2 inhibitors such as empagliflozin and dapagliflozin — may lower a stroke survivor's risk of future heart attack and stroke.

Limit or avoid alcohol

It was previously thought the plant-based nutrients in wine and beer might protect blood vessels. However, that view has changed. Health professionals now know that alcohol is a toxin that worsens health even in moderation.

Drinking alcohol in any amount carries a health risk. And that risk increases as the amount you drink goes up. Alcohol consumption may increase blood pressure, worsen levels of the blood fats called triglycerides and encourage weight gain. Excess alcohol also increases the risk of hemorrhagic stroke.

If you choose to consume alcohol, do so only in moderation. For healthy adults, that means up to one drink a day for women and up to two drinks a day for men. However, for optimal health, alcohol may be best avoided entirely.

Don't use tobacco products

Tobacco users are 2 to 4 times more likely to have a future stroke. In the bloodstream, the chemicals from

nicotine products can make platelets more likely to stick together and form clots. They also may damage the artery walls, increase blood pressure and encourage plaque buildup in your blood vessels. Stopping smoking, however, can quickly lower your stroke risk. Some positive effects even take place within the first 24 hours of quitting.

Know the signs

If you or someone you know has a stroke, it's important to respond quickly. To remember the signs of a stroke, use the acronym BE FAST:

- *Balance* — A person may have trouble walking due to dizziness or weakness in one or both sides of the body.
- *Eyes* — A person may see double or notice vision problems, such as a sudden blurring or blackened vision in one or both eyes.
- *Face* — During a stroke, the face often looks uneven. One side of the mouth may droop.
- *Arm* — A stroke often affects one side of the body. For example, after raising both arms, one arm may begin to fall.
- *Speech* — A person may seem confused, slur words, or be unable to talk or understand speech.
- *Time* — If you notice one or more of these warning signs, call 911 or emergency medical help immediately.

If these symptoms happen to someone you know, check the person's breathing and pulse as you wait for paramedics to arrive. If the person does not have a pulse or isn't breathing, start cardiopulmonary resuscitation (CPR).

If you're not performing CPR, move the person to a side-lying position. Raise and support the person's head. Loosen any restrictive clothing that could cause breathing difficulties. If limb weakness is apparent, support the limb and avoid pulling on it when moving the person. Do not give the person anything to eat or drink.

The warning signs of stroke may be temporary, lasting from a few minutes to 24 hours or longer. Even signs that last only a short time may indicate a stroke, so call for emergency medical help right away.

Ischemic stroke advances

The chances of surviving ischemic stroke have increased dramatically over the past 15 years due to advanced imaging, medications and treatments, says James Klaas, M.D., a neurologist at Mayo Clinic in Rochester, Minnesota.

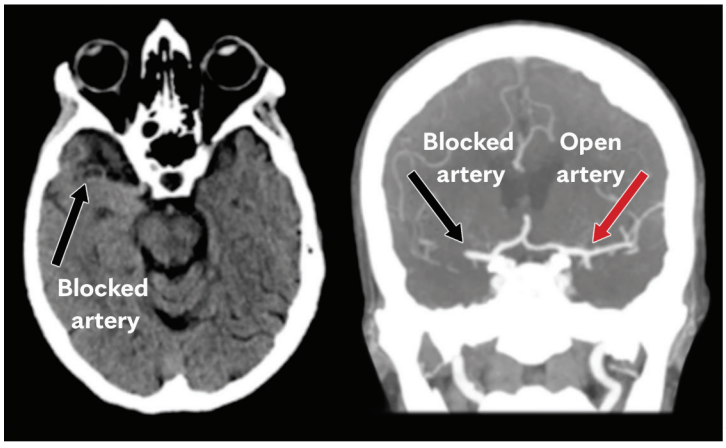
Advanced imaging

Imaging tests can help your emergency care team learn more about your stroke — its type, location and severity — as well as rule out other problems that may be causing your symptoms.

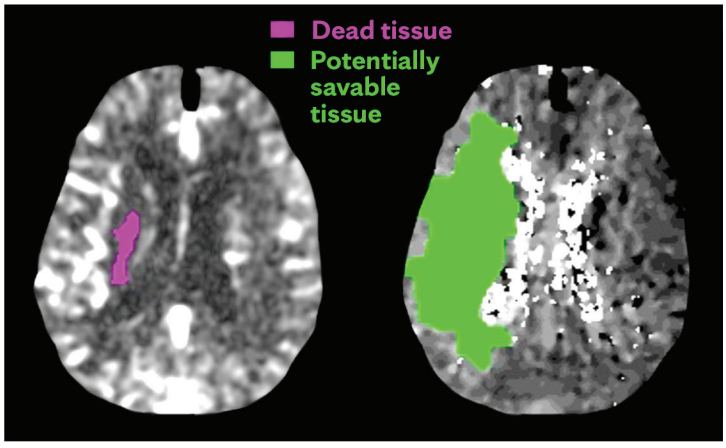
A type of imaging test called perfusion computerized tomography (CT) can help your healthcare team see how blood is flowing in the brain. During an ischemic stroke, the brain tissue closest to the blockage starves and dies. This affected area, known as an infarct, cannot be revived. Other tissue may have reduced blood flow but may not be 100% blocked. Some or all of this tissue often can be saved if blood flow is restored quickly.

Perfusion imaging can help healthcare professionals tell the difference between dead and savable tissue. If there's enough savable tissue, your care team may recommend you undergo surgery to remove the clot, says Dr. Klaas.

The development of perfusion CT imaging has allowed more people to be successfully treated for stroke than ever before. Before perfusion imaging became available, a surgical team would remove clots only in people who arrived at the hospital within six hours of a stroke's onset. With perfusion imaging, medical professionals can more accurately predict who will benefit from stroke surgery. In one study, this type of advanced imaging was used to identify people who might benefit from surgical clot removal, even though as many as 16 hours had elapsed since their strokes.



These two scans show a stroke due to blockage of a brain artery by a blood clot, resulting in a lack of blood flow to part of the brain.



These images depict perfusion CT imaging, which can help identify savable brain tissue. The green area shows tissue that still might be saved with treatment.

Three months after the treatment, 45% of the people who'd had their clots surgically removed could function independently, compared with only 17% of people who didn't have the procedure.

Though advanced perfusion imaging is available at Mayo Clinic and other large medical centers, many smaller hospitals lack this technology. Soon, however, artificial intelligence programs may allow healthcare teams to use regular CT to make these critical decisions, says Dr. Klaas.

"It's very exciting," says Dr. Klaas. "Many smaller hospitals don't have a perfusion scanner — but they all have CT scanners."

Advanced medications

If you're having an ischemic stroke, you may be given powerful emergency intravenous (IV) medicines that can dissolve clots and restore blood flow. When used within 4.5 hours of a stroke, clot-busting medication can increase survival and improve recovery of function.

Older clot-busting medicines were administered in two steps. They required a medical professional first to give a fixed dose and then infuse the rest for over an hour. This two-step process slowed treatment and increased the risk of dosing errors, especially for people who were transferred from one hospital to another while being infused — such as when moving from a regional hospital to a stroke center, says Dr. Klaas.

A newer medicine, tenecteplase (TNKase), is given in one dose as an injection. "The main advantage is ease of administration, which saves time," says Dr. Klaas.

This newer medicine also may be more effective than older medicines at restoring blood flow, Dr. Klaas says. Unlike older clot-busting medicines that only partially dissolve clots, tenecteplase can sometimes completely eliminate a clot, taking away the need for follow-up clot-removal surgery.

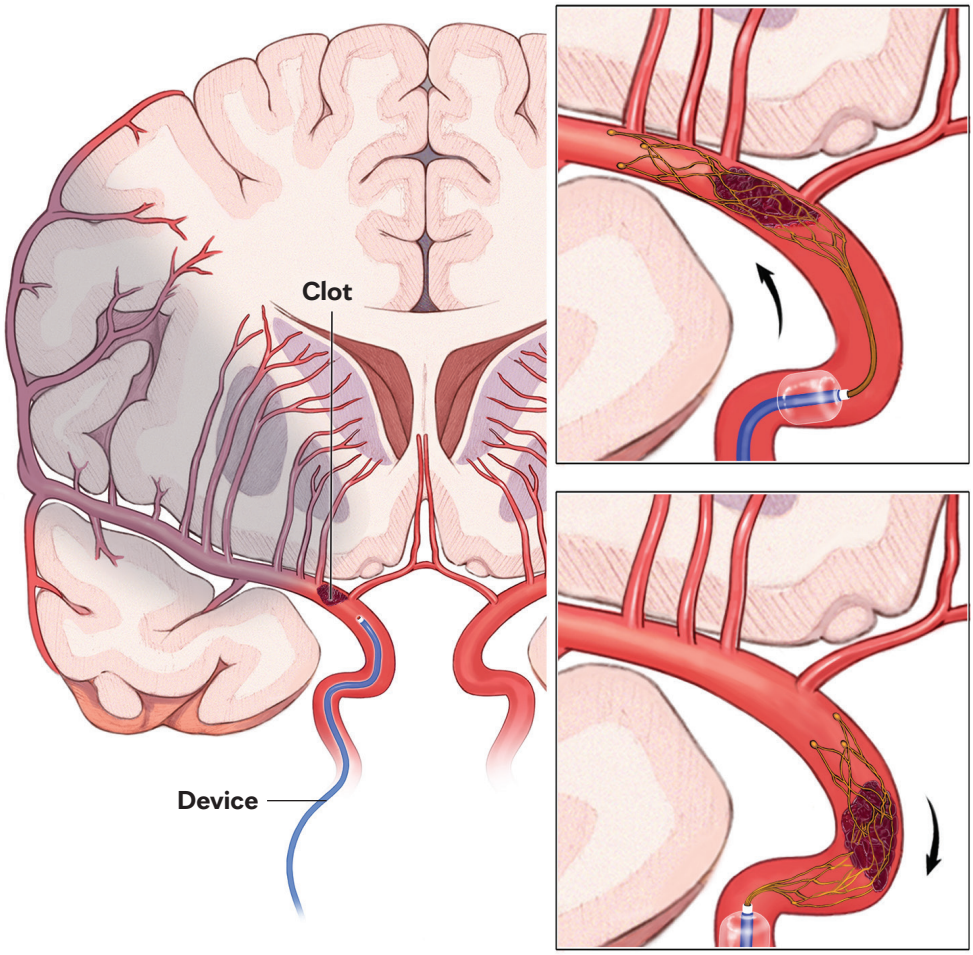
Surgical advances

If clot-busting medicine doesn't completely dissolve a clot involved in an ischemic stroke, your healthcare team may recommend a procedure to remove it. Referred to as a thrombectomy, this procedure can be done using minimally invasive techniques.

First, a healthcare professional may inject a dye into a blood vessel through a small tube called a catheter. The dye helps to show the blood vessels on images of your brain. Guided by these images, a surgeon then threads the catheter through an artery to the blockage in your brain. A device on the end of the catheter will grab or vacuum out the clot.

When done within 24 hours of a stroke's onset in people with a significant amount of savable tissue, surgical clot removal can dramatically reduce disability and improve future quality of life.

To understand the effectiveness of thrombectomy, it helps to understand a statistical concept called number needed to treat (NNT). This calculation describes the number of people who need to be treated with a particular medical therapy in order for one person to receive a beneficial impact. The lower the number, the more effective the therapy. With thrombectomy, the NNT for preventing symptoms that persist more than three months after



In some situations, a procedure to remove an artery-blocking clot — referred to as a thrombectomy — can be done using minimally invasive techniques. Guided by live images, a surgeon threads a tube called a catheter through an artery to the blockage in your brain. A device on the end of the catheter — in this image, a wire snare — will grab or vacuum out the clot.

a stroke has occurred (three-month disability) is 3. "That's an amazingly good number," says Dr. Klaas. "Most medical procedures have a number needed to treat in the 30s or 40s."

In recent years, catheters have become easier to use, safer and more effective, says Dr. Klaas. This has allowed healthcare professionals to remove clots deep in the brain that were previously impossible to remove.

"These harder-to-access types of clots affect a smaller subset of people, but they tend to be life-ending. We now have the ability to treat them," says Dr. Klaas.

Stroke recovery advances

Once medical professionals restore blood flow, the brain needs time to heal. During the days and weeks after a stroke, the function of the brain often is affected by swelling or changes in the brain's chemistry. As the swelling subsides, some lost function will return.

Soon after a stroke, a person may not show signs of being aware. However, as inflammation subsides, the person may awaken and be able to follow commands. Sleep-wake cycles may become more regular, and the person may respond to family members and speak.

During these initial weeks and months after a stroke, the brain also starts to heal in other ways. The area of dead brain tissue does not recover. However, the brain can form new connections, synapses and networks, helping to compensate for the lost tissue.

While some of the brain's recovery happens naturally, the process is swifter and more complete when someone undergoes rehabilitation.

Traditional stroke rehabilitation

Researchers have found that people who participate in a focused stroke rehabilitation program perform better than most people who don't go through stroke rehabilitation. Because of this, stroke rehabilitation is recommended for all people who are affected by stroke.

It's common for rehabilitation to start as soon as 24 to 48 hours after a stroke. beginning in the hospital. Rehabilitation helps you to relearn skills lost after a stroke and often is centered around repetitive actions such as reaching for and grabbing an object.

Traditional rehabilitation includes:

- *Motor-skill exercises* — These routines help improve muscle strength and coordination throughout the body, including the muscles used for balance, walking and swallowing.
- *Mobility training* — You might learn to use mobility aids, such as a walker, cane, wheelchair or ankle brace.
- *Constraint-induced therapy* — An unaffected limb is restrained while you practice moving the affected limb to help improve its function. This therapy is sometimes called forced-use therapy.
- *Range-of-motion therapy* — Certain exercises and treatments can ease muscle tension, known as spasticity, and help you regain range of motion.
- *Therapy for cognitive symptoms* — Occupational and speech therapy can help restore cognitive abilities. These abilities may include memory, processing, problem-solving, social skills, judgment and safety awareness.
- *Therapy to help communication* — Speech therapy can help you regain speaking, listening, writing and comprehension abilities.
- *Psychological evaluation and treatment* — Depression and other mental health issues are typical after a stroke. To address these issues, you also might opt for mental health counseling or participate in a support group.
- *Medicine* — Your healthcare team might recommend an antidepressant or another medicine that affects alertness, agitation or movement.

How long you need rehabilitation depends on the severity of your stroke and related complications. Some stroke survivors recover quickly. However, most people need some form of long-term stroke rehabilitation. This could last for months or years.

In addition, your rehabilitation plan is likely to change during your recovery as you relearn skills and your needs change. With ongoing practice, you can continue to make gains over time.

Advanced stroke rehabilitation

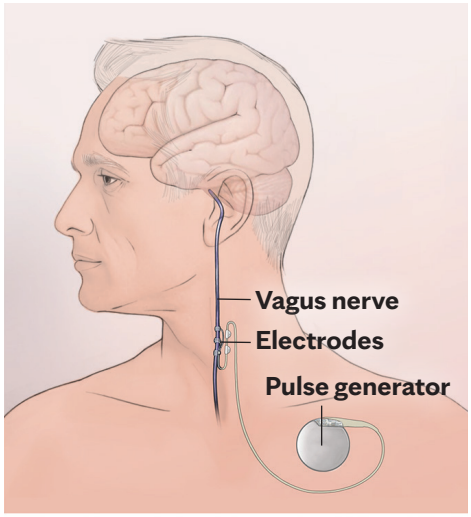
In the past, many people regained function during the first six months after a stroke. After that, their recovery tended to plateau. More recently, however, vagus nerve stimulation (VNS) and other advanced rehabilitation techniques and therapies have expanded this recovery window. These new developments have allowed stroke survivors of all ages to regain skills continually for months or even years.

Contessa Siders had her VNS device implanted in October 2024, more than 10 years after her stroke. A surgical team placed a small battery just under the skin in her chest. Tiny wires attached the battery to the vagus nerve on the left side of her neck. For six weeks after the device was implanted, Siders met with a rehabilitation specialist for intensive sessions. As Siders attempted to perform specific movements with her right hand and arm, the rehabilitation specialist triggered Siders' VNS device to send an electrical impulse to the vagus nerve. The vagus nerve relayed those impulses to Siders' brain, eventually helping her to complete the movement.

"By stimulating the brain, it's thought that these techniques enhance the capability of the brain to form new connections," says Dr. Keser. "That's how recovery happens. The device significantly improves a person's ability to move their hands and arms."

That improvement may allow someone to relearn how to eat without assistance, write, reach for objects or use various types of technology. It also can help people do therapy exercises more consistently.

"When you can use your arm and your hand more, you typically are more motivated to do more therapy.



In the past, many people recovering from stroke regained function during the first six months. After that, their recovery tended to plateau. However, vagus nerve stimulation (VNS) and other advanced rehabilitation techniques and therapies have expanded this recovery window, allowing people of all ages to regain skills continually for months or even years.

This renewed ability to move may help relieve depression after stroke, also improving energy and motivation," says Dr. Keser.

In one clinical study, nearly half of the participants who had VNS therapy significantly increased in motor scores and upper extremity strength. In a different study involving 108 participants, intense rehabilitation that was paired with VNS improved hand and arm function 2 to 3 times more than intense rehabilitation alone.

The improvement Siders experienced was nothing short of stunning.

Initially, Siders noticed only a sensation of electricity near her throat, where the device's leads were stimulating her vagus nerve. However, within six weeks of intense VNS-assisted rehabilitation, areas of Siders' body that hadn't moved in 10 years started to wake back up. She could move her right arm and hand, use scissors, grasp objects and hold cutlery. At Thanksgiving dinner, she sliced the turkey on her plate without help. Afterward, she reached for her 5-year-old son, Soren, lifted him and held him to her chest.

"Mom," he exclaimed. "Holy cow!"

Given that nearly a decade had passed since Siders'stroke, her swift improvement surprised Muhib Khan, M.B.B.S., the Mayo Clinic vascular neurologist who recommended Siders for VNS implantation and oversaw her rehabilitation program. "I suspect that she will continue to regain more function. Many people don't experience meaningful recovery for 3 to 6 months, but she noticed improvement within six weeks," Dr. Khan says.

Advances on the horizon

VNS is a type of neuromodulation, an umbrella term that describes various forms of brain stimulation therapies. Scientists are studying several types of brain stimulation devices and locations to stimulate within the brain. At this point, only VNS — the device Siders had implanted — has been approved by the FDA for arm and hand recovery after a stroke.

Additional neuromodulation therapies under study include:

- *Transcranial magnetic stimulation (TMS)* — Mayo Clinic researchers are investigating the use of TMS to enhance stroke recovery. For this noninvasive treatment, coils are placed against the scalp, creating a magnetic field that stimulates nerve cells in the brain. The therapy is already being used for people with depression and migraine.
- *Transcranial direct current stimulation (tDCS)* — For this therapy, electrodes are placed over the skull. A current from the electrodes penetrates the scalp and skull, reaching the brain tissue underneath. Researchers are studying whether the therapy may help people recover movement and language abilities after a stroke.
- *Deep brain stimulation* — This therapy involves surgeons implanting an electrode into the brain, then using the device to stimulate the brain continuously for several months. It's hoped that, like VNS, the implanted device may one day help people recover more use of their affected hands and arms.

Other possible approaches include spinal cord stimulation and drug and stem cell therapies that might spur nerve regeneration. The ultimate goal is to develop several therapies for boosting stroke recovery, eventually helping stroke survivors regain more function over time. ■

ON THE HORIZON: HOME-BASED REHABILITATION

Currently, stroke rehabilitation programs involve many weeks of in-person therapy. For people like Siders, whose South Dakota home is far from the rehab center, rehabilitation can require staying several weeks in a hotel, a financial cost that is out of reach for many.

To help more people access the rehabilitation they need, healthcare professionals at Mayo Clinic are investigating ways to deliver this therapy remotely via a video feed. Specific procedures — such as the implantation of a device — must take place in an surgical setting. However, medical researchers are studying whether people can learn to operate these devices on their own, with the guidance of a healthcare professional via a video feed.

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