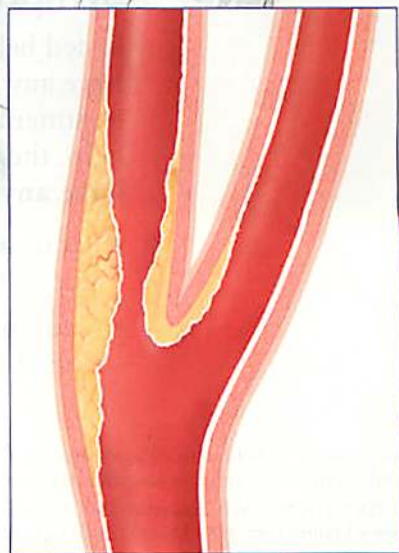
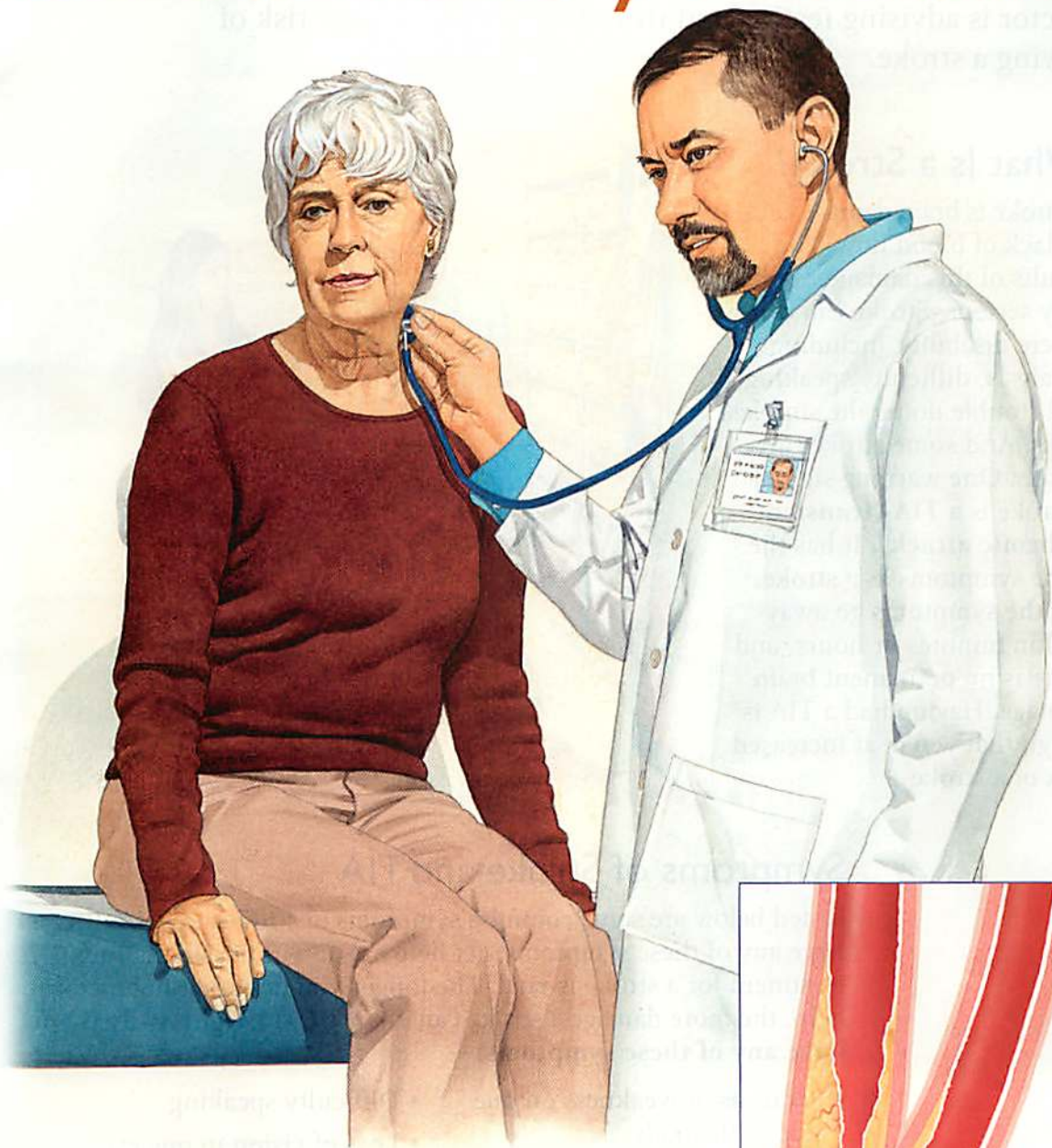


Procedures for Carotid Artery Problems



- Carotid Artery Narrowing (Stenosis)
- Your Risk of Stroke
- Carotid Artery Surgery (Endarterectomy)
- Carotid Artery Stenting

Your Carotid Artery Problem

The **carotid arteries** carry blood to the brain. **Plaque** (a fatty material) can collect inside these arteries, affecting blood flow. This can lead to a **stroke** (sudden loss of brain function). Your doctor is advising testing and treatment to reduce your risk of having a stroke.

What Is a Stroke?

A stroke is brain damage caused by lack of blood flow. The results of this damage can be very serious. Stroke can cause severe disability, including paralysis, difficulty speaking, and trouble doing the simplest tasks. And some strokes are deadly. One warning sign of a stroke is a **TIA (transient ischemic attack)**. It has the same symptoms as a stroke, but the symptoms go away within minutes or hours, and there is no permanent brain damage. Having had a TIA is a sign that you're at increased risk of a stroke.



Symptoms of Stroke and TIA

Listed below are some common symptoms of stroke and TIA. If you have any of these symptoms, get help as soon as possible. Prompt treatment for a stroke is vital: The longer you delay getting medical help, the more damage a stroke can do. **Call 911 right away if you have any of these symptoms:**

- Paralysis or weakness on one side of the body
- Numbness or tingling on one side of the body
- Difficulty speaking
- Loss of vision in one eye
- Drooping of one side of the face

This booklet is not intended as a substitute for professional medical care. Only your doctor can diagnose and treat a medical problem.

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Diagnosing and Treating Carotid Artery Stenosis

If your doctor suspects you have carotid artery stenosis, you'll have tests to confirm the problem. These include imaging tests, such as ultrasound, to check the arteries. If your tests show that treatment is needed, one of two procedures can be used to widen the channel through which blood flows:

- **Carotid endarterectomy**, an open surgery to remove plaque from the artery
- **Carotid artery stenting**, a “minimally invasive” procedure to improve blood flow

Read on to learn more about your condition and these treatment options.



Table of Contents

Your Brain's Blood Supply

How blood gets to the brain, and what happens during a stroke 4

Your Medical Evaluation

What questions and tests to expect 6

Your Treatment Plan

Deciding which treatment is best for you 8

Getting Ready for Treatment

How to prepare for your procedure 9

Surgery to Remove Carotid Plaque

An overview of surgery 10

Carotid Artery Stenting

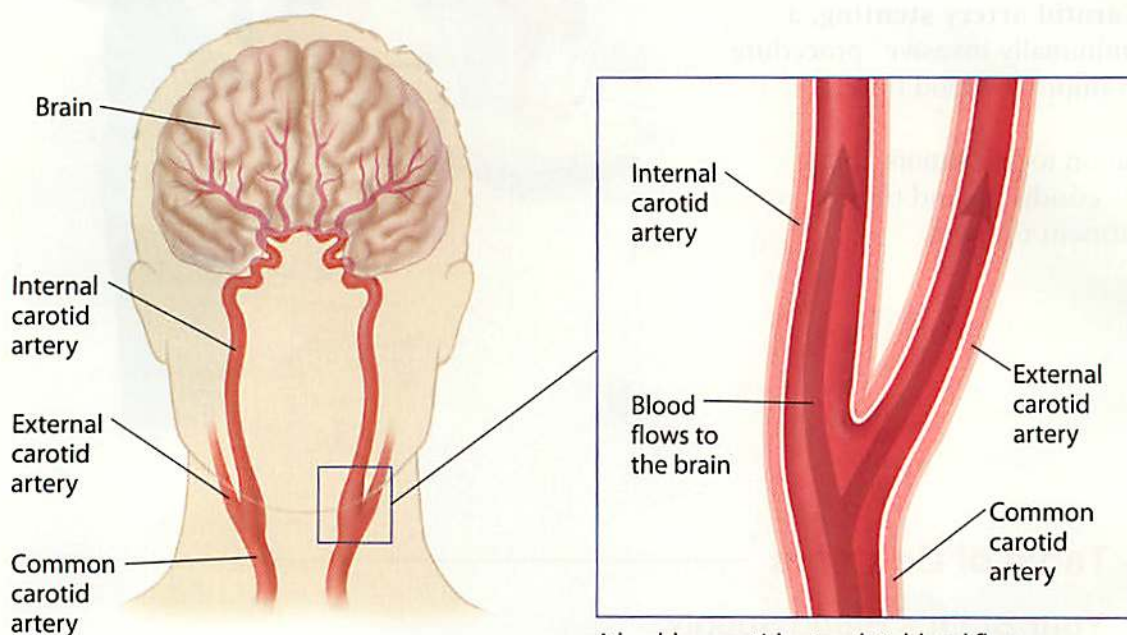
An overview of stenting 12

After Treatment

Your recovery, follow-up, and future health 14

Your Brain's Blood Supply

Blood carries oxygen and nutrients to wherever they're needed in the body. The brain needs a steady supply of blood to work. Problems with the vessels that supply blood to the brain can block blood flow. If this happens, parts of the brain can become starved of oxygen and nutrients. This damages the affected area of the brain, which can impair certain body functions.



A healthy carotid artery lets blood flow easily to the brain.

From the Heart to the Brain

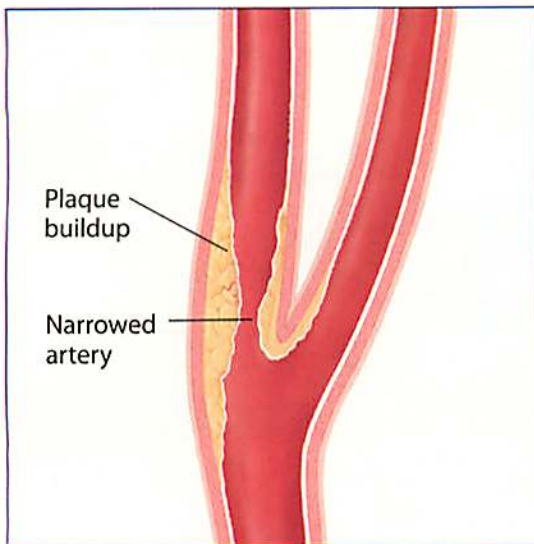
The heart pumps blood throughout the body. Blood vessels called **arteries** carry blood to the limbs and to the organs, including the brain. The carotid arteries are two of the main pathways for blood traveling to the brain. There are two **common carotid arteries**, each traveling up one side of the neck. Each artery divides into two branches. The **internal carotid artery** carries blood into the brain, and the **external carotid artery** supplies blood to the face and scalp.

Healthy Carotid Arteries

When carotid arteries are healthy, the artery walls are smooth. The arteries are open, allowing blood to flow freely to the brain. The brain gets all the blood it needs to function well.

Plaque in the Arteries

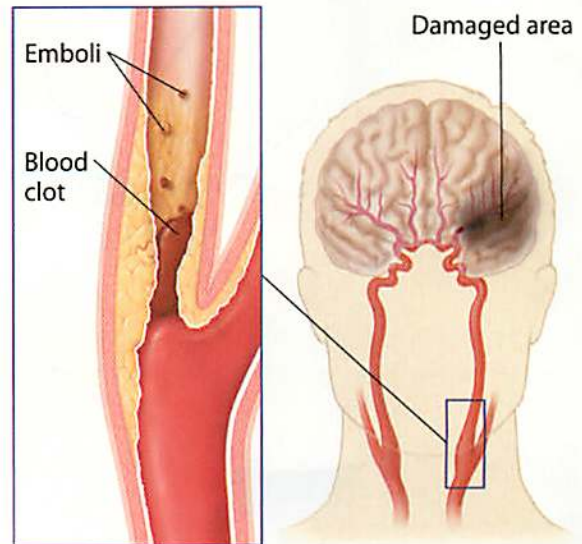
Arteries can become damaged due to risk factors such as smoking, diabetes, and high blood pressure. Heredity (family history) also makes some people more prone to artery damage. A damaged artery no longer has a smooth lining. Cholesterol and other particles in the blood stick to the artery wall and form plaque. A buildup of plaque leads to **stenosis** (narrowing of the artery). This can reduce blood flow.



Problems with blood flow can occur when an artery is narrowed by plaque.

How a Stroke Can Occur

The surface of plaque may be rough. Blood can collect there and form clots. Also, plaque can rupture, causing pieces to break off and enter the bloodstream. At the same time, rupture can produce more blood clots. Fragments of plaque and tiny blood clots (**emboli**) then travel to and block smaller arteries in the brain. This cuts off blood flow to a portion of the brain, resulting in a stroke.



Emboli can enter the bloodstream and travel to the brain.

Brain tissue is damaged when emboli block arteries in the brain.

How a Stroke Affects You

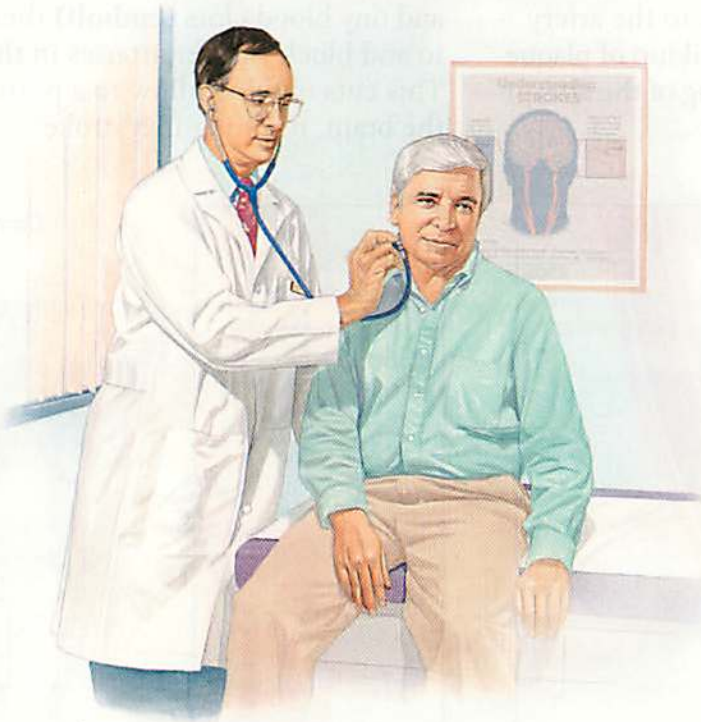
When blood flow is cut off, brain tissue can die, causing loss of brain function. This results in problems such as difficulty speaking or controlling movements. The exact symptoms depend on which part of the brain is affected. Symptoms often occur on one side of the body only, the side opposite the blockage. A stroke does permanent damage that can cause long-lasting loss of function.

Is It a TIA?

A TIA is a short episode of strokelike symptoms. It's sometimes called a "mini-stroke." TIA symptoms go away within 24 hours, but otherwise they are exactly the same as stroke symptoms. If you have stroke symptoms, don't waste time wondering whether you're having a TIA: **Call 911 right away!**

Your Medical Evaluation

Is your carotid artery stenosis severe enough to need treatment? If it is, what's the right treatment for you? An evaluation can give your doctor the information to answer these questions. Your evaluation includes a medical history, an exam, and ultrasound imaging. In some cases, other imaging tests are done.

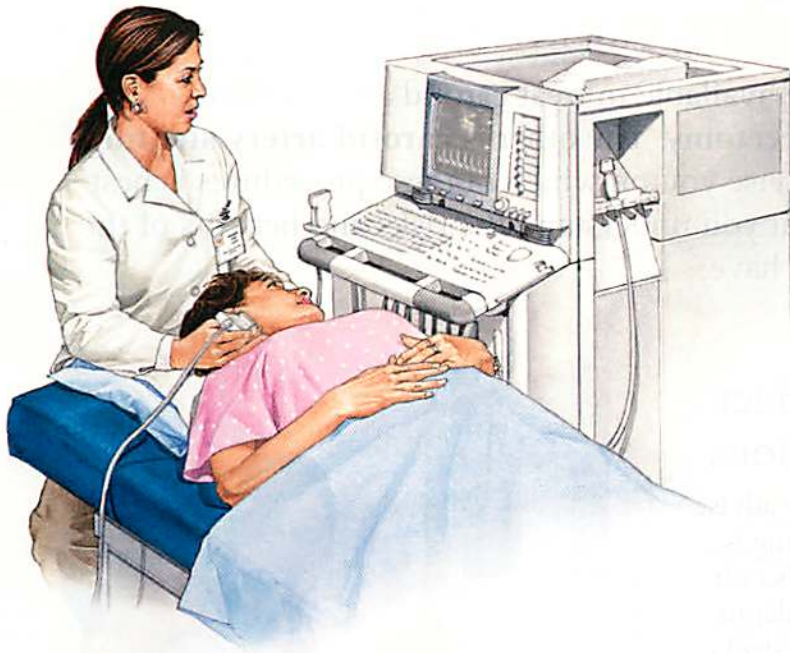


Medical History

Your doctor will ask you to describe any symptoms that you may have had. These include numbness, weakness, and vision or speech problems. You'll also be asked about factors that affect the health of your blood vessels, such as smoking, high cholesterol levels, and high blood pressure (hypertension). You'll describe any current health problems, such as heart disease, kidney disease, lung disease, and diabetes. And you'll be asked about previous treatments and surgeries for artery problems.

Physical Exam

During your physical exam, your doctor will check your blood pressure and your pulse. He or she will also listen for the sound of blood traveling through a narrowed carotid artery. This sound is called a bruit (pronounced "broo-ee"). The blood vessels in your eyes may also be checked for emboli that can indicate carotid artery problems. Your doctor may then test for signs that you may already have had a stroke. This includes checking reflexes, strength, vision or other senses, and the ability to understand and use language.



Duplex Ultrasonography

Ultrasonography (ultrasound) is a noninvasive test. A scanner uses harmless sound waves to create images. A gel is applied to the neck to help the scanner create accurate images. This test checks for stenosis in the carotid arteries. It also shows how stenosis is affecting blood flow through the arteries. The results can indicate whether an artery is narrowed enough to need treatment. Duplex ultrasonography may be the only imaging test you need.

Other Imaging Tests

In certain cases, further testing is helpful. A CT or MRI may be used to check the brain for signs of a previous stroke. Any of the tests below may be used to take pictures of the arteries.

- **CT (computed tomography):** A series of x-rays is taken with a special x-ray machine. Computers use these x-rays to create three-dimensional images. For CT angiography (CTA), contrast fluid ("x-ray dye") may be injected to help arteries show up clearly.
- **MRI (magnetic resonance imaging):** This test uses a strong magnet to create detailed images of the body. A different type of contrast fluid may be used to highlight the arteries.
- **Angiography:** This test is performed using a catheter inserted into an artery in the groin. (See page 12 for more on catheterization.) Contrast fluid is then injected through the catheter into the carotid artery, and x-ray images (angiograms) are taken.

Your Treatment Plan

Two procedures are available to treat carotid artery stenosis. One is **carotid endarterectomy**. The other is **carotid artery stenting**. Your doctor will advise you on which of these procedures is best for you. Be sure that you understand the risks and benefits of the procedure you will have.

Factors That Affect Treatment Options

Your doctor will likely advise a procedure if narrowing is severe. Treatment is also often recommended for moderate narrowing if there are stroke symptoms. The next thing to consider is which type of procedure to perform. Certain factors can make either endarterectomy or stenting the better choice. These factors include your overall health, the amount of narrowing, and your anatomy. Your doctor will consider these and other factors before recommending one of these procedures.



Risks and Complications

Discuss the risks and benefits of each procedure with your doctor. Risks and possible complications of these procedures include, but are not limited to, the following:

Carotid endarterectomy

- TIA or stroke
- Bleeding at the incision site
- Heart attack
- Temporary or permanent hoarseness, numbness, or swallowing problems

Carotid artery stenting

- TIA or stroke
- Bleeding at the puncture site
- Heart attack
- Blood clot in treated vessel
- Heart rhythm problems

Getting Ready for Treatment

You will be told how to prepare for the procedure you will have. This often includes special instructions about medications. Be sure to follow all of your doctor's instructions as you prepare.

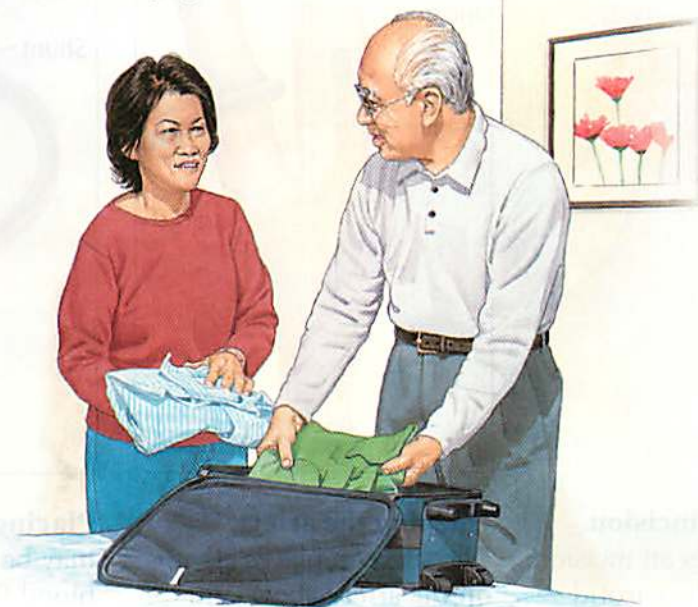
A Week Before

- Tell your doctor about any allergies you have.
- Tell your doctor about medications you take. This includes over-the-counter medications, herbs, and supplements.
- Make medication changes as directed by your doctor. You may be told to stop taking certain medications you normally take. You may also be told to start taking certain medications before surgery.

The Day Before

- Arrange for a ride home when your hospital recovery is finished.
- Don't eat or drink after midnight, the night before the procedure. (Ask your doctor whether you should continue to take any medications during this period.)
- Follow any other special instructions from your doctor.

Before the procedure, pack for a stay of 1 or 2 days in the hospital.



On the Day of the Procedure

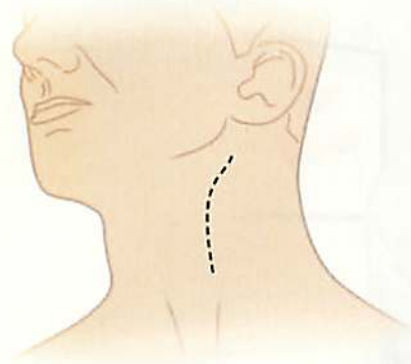
When you arrive at the hospital, you'll change into a hospital gown. Hospital staff will prepare you for the procedure. An IV (intravenous) line will be started to provide you with fluids and medications. You will then be taken to the room where the surgery or stenting procedure is performed.

Surgery to Remove Carotid Plaque

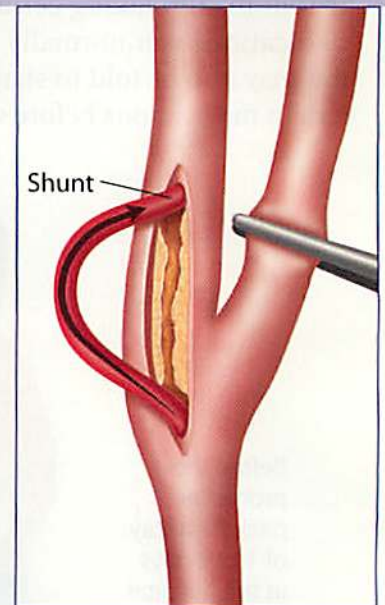
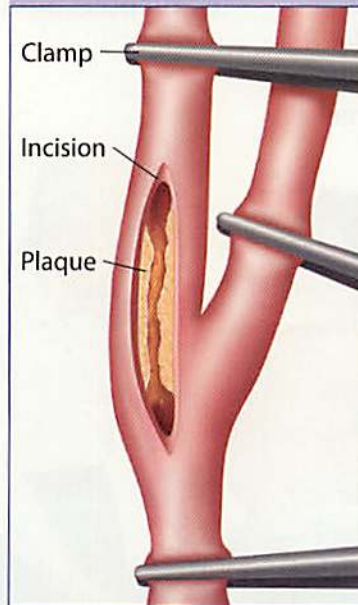
Endarterectomy is the removal of plaque from the carotid artery through an incision in the neck. This surgery has very low risk of stroke or complication. It typically involves a quick recovery with little pain. In most cases, the patient is asleep under general anesthesia during surgery. In some cases, the patient is awake, with local anesthesia to control pain.

How the Endarterectomy Is Performed

An incision is made in the skin over the artery. The artery is opened and plaque is removed. The incisions in the artery and the skin are then closed.



The Procedure



Making the skin incision.

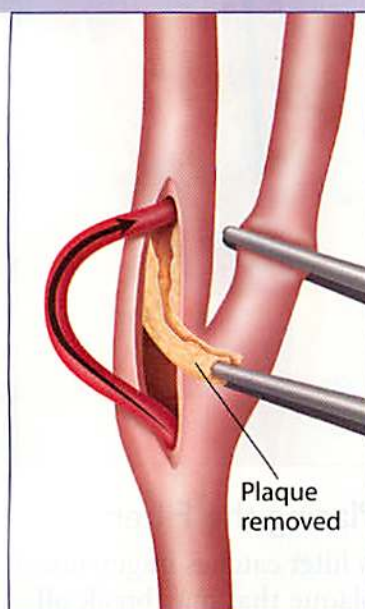
The surgeon makes an incision in the skin over the carotid artery. The image above shows a common incision site and length.

Opening the artery.

The surgeon places clamps on the artery above and below the blockage. This temporarily stops blood flow. The surgeon then makes an incision in the artery itself.

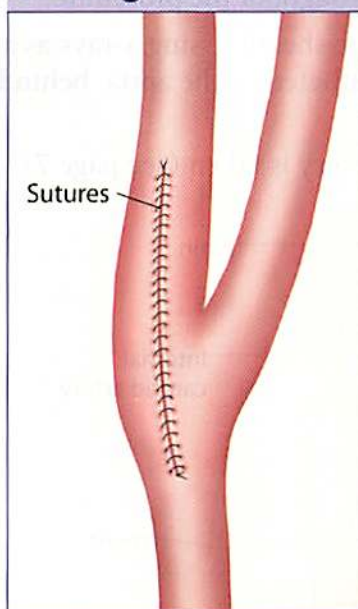
Placing a shunt.

A shunt may be used to preserve blood flow to the brain during the procedure. After the shunt is in place, the clamps are removed from the internal carotid artery. In some cases a shunt is not needed because the brain is receiving enough blood through other arteries.

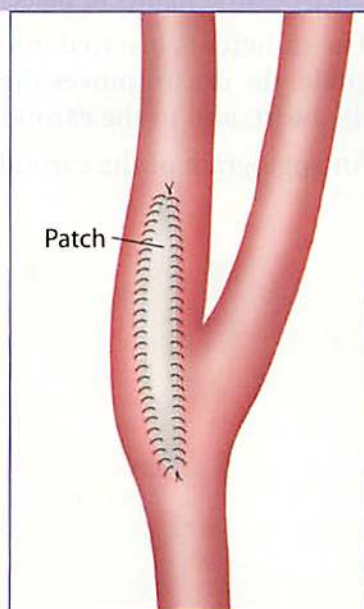


Removing plaque. The surgeon loosens plaque from the artery wall. The plaque is then removed, often in a single piece. The surgeon inspects the artery to confirm that all of the plaque has been removed. He or she then closes the incision using either sutures or a patch.

Closing the Incision



Suturing. The surgeon may suture (stitch) the incision closed. The clamps are then removed. Next, the skin incision is sutured closed. A tube (drain) may be put in place to keep fluids from collecting around the area.



Patching. The surgeon may close the artery with a patch of strong, flexible fabric. The clamps are then removed, the skin incision is sutured, and a drain may be put in place.

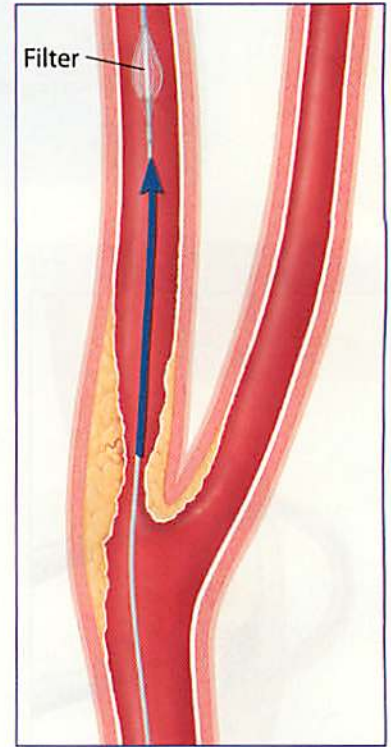
Carotid Artery Stenting

Stenting is the placement of a wire mesh tube (stent) in the artery to hold it open. During the procedure, a long thin tube called a catheter is used to place the stent in the artery. This procedure is performed using local anesthetic. Your doctor will need to talk to you during the procedure, so you'll be awake the entire time.

Inserting the Catheter in the Groin

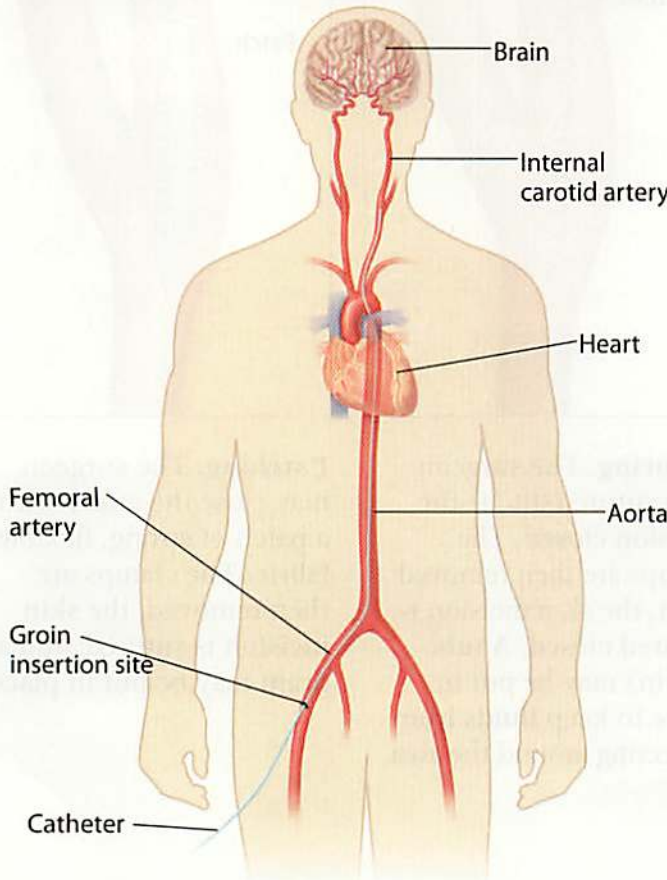
To insert the catheter and prepare for stenting:

- The skin in the area of the insertion site is numbed with local anesthetic. A puncture is made in the femoral artery, a major artery in the groin.
- An introducing sheath (tube) is inserted into the puncture. The sheath remains in place throughout the procedure.
- The catheter is inserted into the sheath. Using x-rays as a guide, the doctor moves the catheter up the aorta, behind the heart, and to the carotid.
- An angiogram of the carotid artery is taken (see page 7).



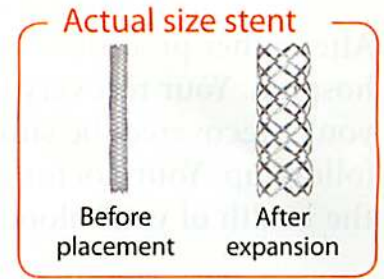
Placing the Filter

A filter catches fragments of plaque that may break off. This prevents them from flowing into the brain and causing a stroke. The catheter is used to place the filter in the artery and advance it past the stenosis. The filter is then opened. It remains in place for the whole procedure. If narrowing is very severe, the artery may need to be widened before the filter is put in place.



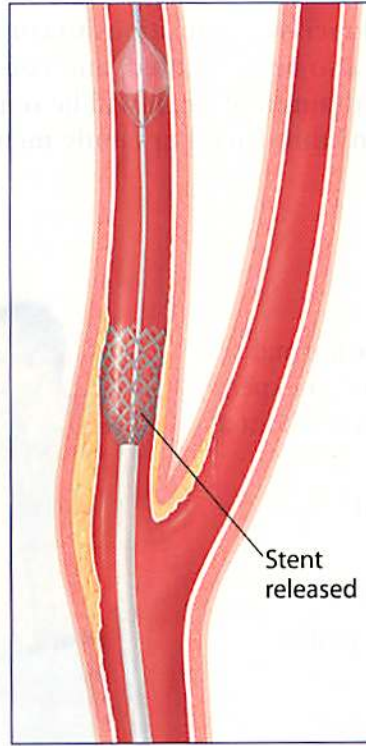
More About the Stent

A carotid artery stent is a flexible wire mesh tube. It may be the same width top and bottom, or it may be tapered. Once it's placed in the artery, it remains there for life. The most common type of carotid artery stent is designed to resist pressure and crushing. This helps it adjust when you move your head and neck.



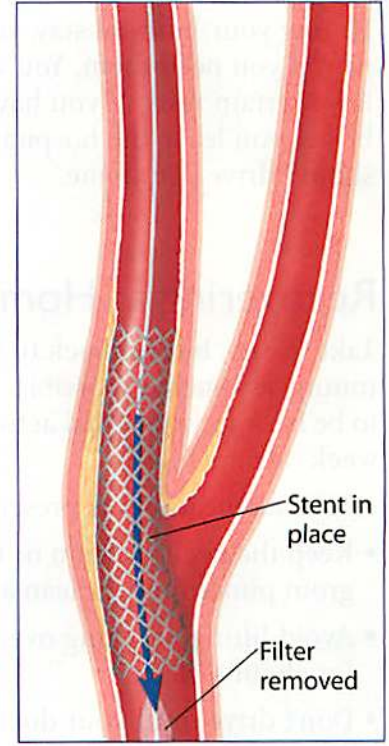
Opening the Artery

A tiny balloon is used to expand the narrowed artery. This is called balloon angioplasty. The uninflated balloon is first moved to the area that is to be widened. The balloon is then inflated, opening up the space inside the artery. You will most likely not feel any pain as this is done. Afterward, the balloon is deflated and removed.



Placing the Stent

The stent is advanced to the site of the plaque. When released, the stent expands until it touches the surface of the plaque. Balloon angioplasty is then used to expand the stent fully and widen the artery. The balloon is withdrawn, leaving the stent in place to hold the artery open.



Finishing Up

An angiogram is taken and compared to the one that was taken at the beginning of the procedure. This is to check on the success of the procedure. Once your doctor is satisfied with the result, the filter and other instruments are withdrawn. The groin insertion site is then closed.

After Treatment

After either procedure, you will most likely stay 1 or 2 days in the hospital. Your recovery at home should take about a week. After you're recovered, be sure to follow your doctor's instructions for follow-up. Your doctor can also advise you on ways to improve the health of your blood vessels and your whole body.

Recovering in the Hospital

During your hospital stay, you'll receive medications to control pain if you need them. You will also be monitored, and you may have certain tests. If you have a drain in place, it will be removed before you leave the hospital. An adult friend or family member should drive you home.

Recovering at Home

Take it easy, but get back to your normal routine as much as possible. You can expect to be back to your usual activities in about a week. Meanwhile:

- Take medications as prescribed.
- Keep the neck incision or the groin puncture site clean and dry.
- Avoid lifting anything over 10 pounds for about a week.
- Don't drive until your doctor clears you to do so.
- If you had an endarterectomy, shave carefully around the incision. You may want to use an electric razor.
- If you had stenting, shower instead of taking tub baths for a few days.



Ask a friend or family member to help with chores, especially those that involve lifting.

When to Call Your Doctor

If you have stroke symptoms, call 911. Call your doctor if:

- You have problems at the incision or puncture site, such as swelling, redness, warmth, or increasing pain.
- You have a cold or painful leg or foot (after stenting).
- You experience mental confusion or headaches.

Follow-Up

After the procedure, you'll have a follow-up exam and tests. Ultrasound or other imaging tests may be needed regularly from now on. Restenosis (re-narrowing of the artery) is uncommon after either treatment, but it does sometimes occur. If so, you may need to have another procedure.



Controlling Arterial Disease

The same factors that put you at risk of stroke also put you at risk of other health problems. These include heart attack, kidney problems, and other types of arterial disease. Lifestyle changes and medications can help treat these risk factors and keep you healthier. See the back cover of this booklet for resources to help you get started on these changes:

- **Exercise regularly.** A common goal is to exercise 30 minutes or more a day, most days. Talk to your doctor before starting an exercise program.
- **Make healthier food choices.** Include more vegetables, fruits, whole grains, and low-fat dairy products. Meanwhile, cut back on animal fats, sweets, and processed foods. A dietitian can help you learn more.
- **Quit smoking.** Smoking increases the risk of blood clots and also increases blood pressure. Talk to your doctor about how to quit for good.
- **Take medications as directed.** You may be prescribed medications to help control blood cholesterol, diabetes, and hypertension. Controlling these problems helps keep arteries healthier. You may also be prescribed medications to prevent blood clots.

Looking Toward the Future

Treatment for carotid artery stenosis can reduce your risk of stroke. But the conditions that led to the problem may still exist. Talk with your doctor about what you can do to improve the health of your arteries and your overall health. The resources listed below can help.

Resources

- **Society for Vascular Surgery**
www.vascularweb.org
- **American Stroke Association**
www.strokeassociation.org
- **Society of Interventional Radiology**
www.sirweb.org
- **National Cholesterol Education Program**
www.nhlbi.nih.gov/chd



Consultant:

Christopher K. Zarins, MD, Vascular Surgery

With contributions by:

Frank Arko, MD, Vascular Surgery
Martin R. Back, MD, Vascular Surgery
George E. Bone, MD, Vascular Surgery
Maria Rodriguez Gomes, MD, Interventional Radiology
M. Eileen Walsh, PhD, APRN, CVN, Vascular Surgery
Harold J. Welch, MD, Vascular Surgery
Jack Zeltzer, MD, Vascular Surgery

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