

**ALDERFER & TRAVIS CARDIOLOGY, PC**  
670 Lawn Ave., Suite 3A Sellersville, PA 18960  
Tel (215)257-9500 FAX (215) 257-9500

## **Carotid Endarterectomy**

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### **What is a carotid endarterectomy?**

A carotid endarterectomy is a surgical procedure in which a doctor removes fatty deposits from one of the two main arteries in the neck supplying blood to the brain. Carotid artery problems become more common as people age. The disease process that causes the buildup of fat and other material on the artery walls is called atherosclerosis, popularly known as "hardening of the arteries." The fatty deposit is called plaque; the narrowing of the artery is called stenosis. The degree of stenosis is usually expressed as a percentage of the normal diameter of the opening.

### **Why is the surgery performed?**

Carotid endarterectomies are performed to prevent stroke. Two large clinical trials supported by the National Institute of Neurological Disorders and Stroke (NINDS) have identified specific individuals for whom the surgery is highly beneficial when performed by surgeons and in institutions that can match the standards set in those studies. The surgery has been found highly beneficial for persons who have already had a stroke or experienced the warning signs of a stroke and have a severe stenosis of 70 percent to 99 percent. In this group, surgery reduces the estimated 2-year risk of stroke by more than 80 percent, from greater than 1 in 4 to less than 1 in 10.

In a second trial, the procedure has also been found highly beneficial for persons who are symptom-free but have a severe stenosis of 60 percent to 99 percent. In this group, the surgery reduces the estimated 5-year risk of stroke by more than one-half, from about 1 in 10 to less than 1 in 20.

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

A stroke occurs when brain cells die because of decreased blood flow to the brain. In some cases, small pieces of plaque in the carotid artery may break loose and block an artery in the brain. The narrowed opening in the carotid artery can be a source of blood clots that travel to the brain, can trap blood clots from other areas of the body, or can become completely clogged.

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

Warning signs and symptoms of stroke include: sudden weakness or numbness of the face, arm or leg; sudden dimness or loss of vision, particularly in one eye; sudden difficulty speaking or understanding speech; sudden severe headache with no known cause; and unexplained dizziness, unsteadiness, or sudden falls, especially with any of the other signs. Warning signs may last a few moments and then disappear. When they disappear within 24 hours or less, they are called a transient ischemic attacks (TIA). See also Brain Attack: Stroke Warning Signs and Risk Factors and Brain Basics: Preventing Stroke.

### **How important is a blockage as a cause of stroke?**

A blockage of a blood vessel is the most frequent cause of stroke and is responsible for about 75 percent of the nearly 150,000 U.S. stroke deaths each year. Stroke ranks as the third leading killer in the United States after heart disease and cancer. There are 500,000 to 600,000 new strokes in the United States each year. As many as 3 million Americans have survived a stroke with more than 2 million of them sustaining some permanent disability. The overall cost of stroke to the nation is \$30 billion a year.

### **How many carotid endarterectomies are performed each year?**

In 1992, the most recent year for which statistics are available from the National Hospital Discharge Survey, there were about 91,000 carotid endarterectomies performed in the United States. The procedure has a 40-year history. It was first described in the mid-1950s. It began to be used increasingly as a stroke prevention measure in the 1960s and 1970s. Its use peaked in the mid-1980s when more than 100,000 operations were performed each year. At that time, several authorities began to question the trend and the risk-benefit ratio for some groups, and the use of the procedure dropped precipitously. The NINDS-supported North American Symptomatic Carotid

Endarterectomy Trial (NASCET) and the NINDS-supported Asymptomatic Carotid Atherosclerosis Study (ACAS) were launched in the mid-1980s to identify the specific groups of people with carotid artery disease who would clearly benefit from the procedure.

### **How much does a carotid endarterectomy cost?**

The total average cost for the diagnostic tests, surgical procedure, hospitalization, and followup care is about \$15,000.

### **How risky is the surgery?**

The degree of risk varies with the hospital, the surgeon, and the underlying disease conditions.

### **How is carotid artery disease diagnosed?**

In most cases, the disease can be detected during a normal checkup with a physician. Some of the tests a physician can use or order include history and physical exam, doppler ultrasound imaging, oculoplethysmography (OPG), computed tomography (CT), arteriography and digital subtraction angiography (DSA), magnetic resonance angiography (MRA). Frequently these procedures are carried out in a stepwise fashion: from a doctor's evaluation of signs and symptoms to ultrasound, with arteriography, DSA or MRA reserved for difficult diagnoses.

History and physical exam. A doctor will ask about symptoms of a stroke such as numbness or muscle weakness, speech or vision difficulties, or lightheadedness. Using a stethoscope, a doctor may hear a rushing sound, called a bruit (pronounced "brew-ee"), in the carotid artery. Unfortunately, dangerous levels of disease sometimes fail to make a sound, and some blockages with a low risk can make a sound.

Doppler ultrasound imaging. This is a painless, noninvasive test in which sound waves above the range of human hearing are sent into the neck. Echoes bounce off the moving blood and the tissue in the artery and can be formed into an image. Ultrasound is fast, risk-free, relatively inexpensive and painless. Unfortunately, there is a small possibility of error in an ultrasound study. A stenosis with a high level of risk will occasionally be incorrectly reported as a low-risk finding. Conversely, a stenosis with a low level of risk will sometimes be reported as a high level of risk. In carefully calibrated ultrasound laboratories, ultrasound studies can be up to 95 percent accurate and offer visualization of the anatomy, evaluation of the blood flow rate and turbulence, and characterization of the plaque. Performing an ultrasound study requires a great deal of skill which is not always available.

Oculoplethysmography (OPG). This procedure measures the pulsation of the arteries in the back of the eye. It is used as an indirect check for blockages in the carotid arteries. Computed Tomography (CT). This test produces a series of cross-sectional X-rays of the head and brain. It cannot detect carotid artery disease but may be ordered by a doctor to investigate other possible causes of symptoms. The test is also called a CAT scan, for computer assisted tomography.

Arteriography and Digital Subtraction Angiography (DSA). Arteriography is an X-ray of the

carotid artery taken when a special dye is injected into another artery in the leg or arm. A burning sensation may be felt when the dye is injected. DSA is also an X-ray study of the carotid artery. It is similar to arteriography except that less dye is used. A person having a DSA must remain still during the test. These invasive procedures are more expensive and carry their own small risk of causing a stroke.

Magnetic Resonance Angiography (MRA). This is a very new imaging technique that is more accurate than ultrasound yet avoids the risks associated with X-rays and dye injection. An MRA is a type of magnetic resonance image that uses special software to create an image of the arteries in the brain. A magnetic resonance image uses harmless but powerful magnetic fields to create a highly detailed image of the body's tissues.

**What is "best medical therapy" for stroke prevention?**

The mainstay of stroke prevention is risk factor management: smoking cessation, treatment of high blood pressure and heart disease, and control of blood sugar levels among persons with diabetes. Additionally, physicians may prescribe aspirin, warfarin, or ticlopidine. See also Brain Basics: Preventing Stroke.

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National Institutes of Health  
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