



American
Association of
Neurological
Surgeons

CEREBROVASCULAR DISEASE

PATIENT INFORMATION

This resource, developed by neurosurgeons, provides patients and their families trustworthy information on neurosurgical conditions and treatments.

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The word cerebrovascular is made up of two parts – "cerebro" which refers to the large part of the brain, and "vascular" which means arteries and veins. Together, the word cerebrovascular refers to blood flow in the brain. The term cerebrovascular disease includes all disorders in which an area of the brain is temporarily or permanently affected by ischemia or bleeding and one or more of the cerebral blood vessels are involved in the pathological process. Cerebrovascular disease includes stroke, carotid stenosis, vertebral stenosis and intracranial stenosis, aneurysms, and vascular malformations.

Restrictions in blood flow may occur from vessel narrowing (stenosis), clot formation (thrombosis), blockage (embolism) or blood vessel rupture (hemorrhage). Lack of sufficient blood flow (ischemia) affects brain tissue and may cause a stroke.

Blood Flow to the Brain

The heart pumps blood up to the brain through two sets of arteries, the carotid arteries and the vertebral arteries. The carotid arteries are located in the front of the neck and are what you feel when you take your pulse just under your jaw. The carotid arteries split into the external and internal arteries near the top of the neck with the external carotid arteries supplying blood to the face and the internal carotid arteries going into the skull. Inside the skull, the internal carotid arteries branch into two large arteries – the anterior cerebral and middle cerebral arteries and several smaller arteries – the ophthalmic, posterior communicating and anterior choroidal arteries. These arteries supply blood to the front two-thirds of the brain.

The vertebral arteries extend along side the spinal column and cannot be felt from the outside. The vertebral arteries join to form a single basilar artery near the brain stem, which is located near the base of the skull. The vertebrobasilar system sends many small branches into the brain stem and branches off to form the posterior cerebellar and posterior meningeal arteries, which supply the back third of the brain. The jugular and other veins carry blood out of the brain.

Because the brain relies on only two sets of major arteries for its blood supply, it is very important that these arteries are healthy. Often, the underlying cause of an ischemic stroke is carotid arteries blocked with a fatty buildup, called plaque. During a hemorrhagic stroke, an artery in or on the surface of the brain has ruptured or leaks, causing bleeding and damage in or around the brain.

Whatever the underlying condition and cause are, it is crucial that proper blood flow and oxygen be restored to the brain as soon as possible. Without oxygen and important nutrients, the affected brain cells are either damaged or die within a few minutes. Once brain cells die, they cannot regenerate, and devastating damage may occur, sometimes resulting in physical, cognitive and mental disabilities.

Cerebrovascular Disease Statistics

- There were an estimated 157,803 cerebrovascular-related deaths in 2003; 138,397 of which were in people age 65 and older.
- Cerebrovascular disease is the most common life-threatening neurological event in the U.S. Intracranial atherosclerosis is responsible for approximately 40,000 of these attacks per year, representing 10 percent of all ischemic strokes.
- Stroke is the third leading cause of death in the United States. Of the more than 700,000 people affected every year, about 500,000 of these are first attacks and 200,000 are recurrent. About 25 percent of people who recover from their first stroke will have another stroke within five years.
- Stroke is a leading cause of serious long-term disability, with an estimated 5.4 million stroke survivors currently alive today. The American Heart Association estimates that in 2003, stroke cost about \$51.2 billion in both direct and indirect costs in the U.S. alone.
- The most recent prevalence statistics from the American Heart Association estimate that 5,400,000 people have experienced stroke.
- Every year, an estimated 30,000 people in the United States experience a ruptured cerebral aneurysm and as many as 6 percent may have an unruptured aneurysm.
- Arteriovenous malformations (AVMs) are present in about 1 percent of the general population. The risk of hemorrhage from an AVM is 4 percent per year with a 15 percent chance of stroke or death with each hemorrhage.

Cerebrovascular Diagnostic Tests

The majority of cerebrovascular problems can be identified through diagnostic imaging tests. These tests allow neurosurgeons to view the arteries and vessels in and around the brain and the brain tissue itself.

Cerebral angiography (also called vertebral angiogram, carotid angiogram): Arteries are not normally seen in an X-ray, so contrast dye is utilized. The patient is given a local anesthetic, the artery is punctured, usually in the leg, and a needle is inserted into the artery. A catheter (a long, narrow, flexible tube) is inserted through the needle and into the artery. It is then threaded through the main vessels of the abdomen and chest until it is properly placed in the arteries of the neck. This procedure is monitored by a fluoroscope (a special X-ray that projects the images on a TV monitor). The contrast dye is then injected into the neck area through the catheter and X-ray pictures are taken.

Carotid duplex (also called carotid ultrasound): In this procedure, ultrasound is used to help detect plaque, blood clots or other problems with blood flow in the carotid arteries. A water-soluble gel is placed on the skin where the transducer (a handheld device that directs the high-frequency sound waves to the arteries being tested) is to be placed. The gel helps transmit the sound to the skin surface. The ultrasound is turned on and images of the carotid arteries and pulse wave forms are obtained. There are no known risks and this test is noninvasive and painless.

Computed tomography (CT or CAT scan): A diagnostic image created after a computer reads x-rays. In some cases, a medication will be injected through a vein to help highlight brain structures. Bone, blood and brain tissue have very different densities and can easily be distinguished on a CT scan. A CT scan is a useful diagnostic test for hemorrhagic strokes because blood can easily be seen. However, damage from an ischemic stroke may not be revealed on a CT scan for several hours or days and the individual arteries in the brain cannot be seen. CTA (CT angiography) allows clinicians to see blood vessels of the head and neck and is increasingly being used instead of an invasive angiogram.

Doppler ultrasound: A water-soluble gel is placed on the transducer (a handheld device that directs the high-frequency sound waves to the artery or vein being tested) and the skin over the veins of the extremity being tested. There is a "swishing" sound on the Doppler if the venous system is normal. Both the superficial and deep venous systems are evaluated. There are no known risks and this test is noninvasive and painless.

Electroencephalogram (EEG): A diagnostic test using small metal discs (electrodes) placed on a person's scalp to pick up electrical impulses. These electrical signals are printed out as brain waves.

Lumbar puncture (spinal tap): An invasive diagnostic test that uses a needle to remove a sample of cerebrospinal fluid from the space surrounding the spinal cord. This test can be helpful in detecting bleeding caused by a cerebral hemorrhage.

Magnetic Resonance Imaging (MRI): A diagnostic test that produces three-dimensional images of body structures using magnetic fields and computer technology. It can clearly show various types of nerve tissue and clear pictures of the brain stem and posterior brain. An MRI of the brain can help determine whether there are signs of prior mini-strokes. This test is noninvasive, although some patients may experience claustrophobia in the imager.

Magnetic Resonance Angiogram (MRA): This is a noninvasive study which is conducted in a Magnetic Resonance Imager (MRI). The magnetic images are assembled by a computer to provide an image of the arteries in the head and neck. The MRA shows the actual blood vessels in the neck and brain and can help detect blockage and aneurysms.

Stroke

Stroke is an abrupt interruption of constant blood flow to the brain that causes loss of neurological function. The interruption of blood flow can be caused by a blockage, leading to the more common ischemic stroke, or by bleeding in the brain, leading to the more deadly hemorrhagic stroke. Ischemic stroke constitutes an estimated 80 percent of all stroke cases. Stroke may occur suddenly, sometimes with little or no warning, and the results can be devastating.

Stroke Symptoms

Warning signs may include some or all of the following symptoms, which are usually sudden:

- Dizziness, nausea, or vomiting
- Unusually severe headache
- Confusion, disorientation or memory loss
- Numbness, weakness in an arm, leg or the face, especially on one side
- Abnormal or slurred speech
- Difficulty with comprehension
- Loss of vision or difficulty seeing
- Loss of balance, coordination or the ability to walk

Types of Stroke and Treatment

Ischemic Stroke

Ischemic stroke is by far the most common type of stroke, accounting for a large majority of strokes. There are two types of ischemic stroke: thrombotic and embolic. A thrombotic stroke occurs when a blood clot, called a thrombus, blocks an artery to the brain and stops blood flow. An embolic stroke occurs when a piece of plaque or thrombus travels from its original site and blocks an artery downstream. The material that has moved is called an embolus. How much of the brain is damaged or affected depends on exactly how far downstream in the artery the blockage occurs.

In most cases, the carotid or vertebral arteries do not become completely blocked and a small stream of blood trickles to the brain. The reduced blood flow to the brain starves the cells of nutrients and quickly leads to a malfunctioning of the cells. As a part of the brain stops functioning, symptoms of a stroke occur. During a stroke, there is a core area where blood is almost completely cut off and the cells die within five minutes. However, there is a much larger area known as the ischemic penumbra that surrounds the core of dead cells. The ischemic penumbra consists of cells that are impaired and cannot function, but are still alive. These cells are called idling cells, and they can survive in this state for about three hours.

Ischemic stroke is treated by removing the obstruction and restoring blood flow to the brain. One treatment for ischemic stroke is the FDA-approved drug, tissue plasminogen activator (tPA), which must be administered within a three-hour window from the onset of symptoms to work best. Unfortunately, only 3 to 5 percent of those who suffer a stroke reach the hospital in time to be considered for this treatment. This medication carries a risk for increased intracranial hemorrhage and is not used for hemorrhagic stroke. For patients beyond the three-hour time window, intrarterial thrombolysis with drugs or mechanical devices may be an option. Carotid endarterectomy, and or stenting of the cervical and intracranial vessels, may help reduce recurrent stroke in some cases.

The Merci Retriever, approved recently by the FDA, is a corkscrew-shaped device used to help remove blood clots from the arteries of stroke patients. A small incision is made in the patient's groin, into which a small catheter is fed until it reaches the arteries in the neck. At the neck, a small catheter inside the larger catheter is guided through the arteries until it reaches the brain clot. The Merci Retriever, a straight wire inside the small catheter pokes out beyond the clot and automatically coils into a corkscrew shape. It is pulled back into the clot, the corkscrew spinning and grabbing the clot. A balloon inflates in the neck artery, cutting off blood flow, so the device can pull the clot out of the brain safely. The clot is removed through the catheter with a syringe.

Hemorrhagic Stroke

A hemorrhagic stroke can be caused by hypertension, rupture of an aneurysm or vascular malformation or as a complication of anticoagulation medications. An intracerebral hemorrhage occurs when there is bleeding directly into the brain tissue, which often forms a clot within the brain. A subarachnoid hemorrhage occurs when the bleeding fills the cerebrospinal fluid spaces around the brain. Both conditions are very serious.

Hemorrhagic stroke usually requires surgery to relieve intracranial (within the skull) pressure caused by bleeding. Surgical treatment for hemorrhagic stroke caused by an aneurysm or defective blood vessel can prevent additional strokes. Surgery may be performed to seal off the defective blood vessel and redirect blood flow to other vessels that supply blood to the same region of the brain.

Endovascular treatment involves inserting a long, thin, flexible tube (catheter) into a major artery, usually in the thigh, guiding it to the aneurysm or the defective blood vessel and inserting tiny platinum coils (called stents) into the blood vessel through the catheter. Stents support the blood vessel to prevent further damage and additional strokes.

Recovery and rehabilitation are important aspects of stroke treatment. In some cases, undamaged areas of the brain may be able to perform functions that were lost when the stroke occurred. Rehabilitation includes physical therapy, speech therapy and occupational therapy.

Regardless of what type of stroke has been suffered, it is critical that victims receive emergency medical treatment as soon as possible for the best possible outcome to be realized. By learning the signs and symptoms of stroke and treating risk factors preventively, it is possible to help avert the devastating results of this disease.

Transient Ischemic Attack (TIA)

A TIA is a temporary cerebrovascular event that leaves no permanent damage. Most likely an artery to the brain is temporarily blocked, causing stroke-like symptoms, but the blockage dislodges before any permanent damage occurs.

Symptoms of a TIA may be similar to stroke, but they resolve quickly. In fact, symptoms may be so vague and fleeting that people just "brush" them off, especially when they last just a few minutes. TIA symptoms include:

- 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

While there is no treatment for the TIA itself, it is essential that the source of the TIA be identified and appropriately treated before another attack occurs. If you experience TIA symptoms, seek emergency medical help and notify your primary care physician immediately. About 30 percent of all people who suffer a major stroke experience a prior TIA, and 10 percent of all TIA victims suffer a stroke within two weeks. The quicker you seek medical attention, the sooner a diagnosis can be made and a course of treatment started. Early intervention is essential to effectively preventing a major stroke. Treatment options for TIA patients focus on treating carotid artery disease or cardiac problems.

Risk Factors

Although they are more common in older adults, strokes can occur at any age. Stroke prevention can help reduce disability and death caused by the disease. Controllable or treatable risk factors for stroke include:

- Smoking: Decrease risk by quitting smoking. Risk may be increased further with the use some forms of oral contraceptives and are a smoker. There is recent evidence that long-term secondhand smoke exposure may increase the risk of stroke.
- High blood pressure: Blood pressure of 140/90 mm Hg or higher is the most important risk factor for stroke. Controlling blood pressure is crucial to stroke prevention.
- Carotid or other artery disease: The carotid arteries in the neck supply blood to the brain. A carotid artery narrowed by fatty deposits from atherosclerosis (plaque buildups in artery walls) may become blocked by a blood clot.
- History of transient ischemic attacks (TIAs).
- Diabetes: It is crucial to control blood sugar levels, blood pressure and cholesterol levels. Diabetes, especially when untreated, puts one at greater risk of stroke and has many other serious health implications.
- High blood cholesterol: A high level of total cholesterol in the blood (240 mg/dL or higher) is a major risk factor for heart disease, which raises the risk of stroke.
- Physical inactivity and obesity: Being inactive, obese or both can increase the risk of high blood pressure, high blood cholesterol, diabetes, heart disease and stroke.
- Recent research shows evidence that people receiving hormone replacement therapy (HRT) have an overall 29 percent increased risk of stroke, in particular ischemic stroke.

Uncontrollable risk factors include:

- Age: People of all ages, including children, have strokes. But the older you are, the greater your risk of stroke.
- Gender: Stroke is more common in men than in women.
- Heredity and race: There is a greater risk of stroke if a parent, grandparent, sister or brother has had a stroke. Blacks have a much higher risk of death from a stroke than Caucasians do, partly because they are more prone to having high blood pressure, diabetes and obesity.
- Prior stroke or heart attack: Those who have had a stroke are at much higher risk of having another one. Those who have had a heart attack are also at higher risk of having a stroke.

Carotid Stenosis

The carotid arteries supply oxygen-rich blood to the brain. Plaque forms when the internal carotid arteries become blocked by fat and cholesterol buildup. This process is called atherosclerosis. Severe blockage is called carotid stenosis. Carotid stenosis may cause a TIA.

Carotid stenosis is frequently asymptomatic. A doctor may detect it through an abnormal sound called a bruit (BROO'e) when listening to the carotid arteries with a stethoscope. Patients usually first undergo a thorough physical examination. This examination can reveal specific neurological, motor and sensory deficits that can provide clues about both the extent and location of the blockage. If the physician suspects stenosis, diagnostic tests such as Doppler ultrasound, carotid duplex or cerebral angiography will be recommended.

Medical Treatment

Treatment is determined by the extent of the narrowing and the condition of the patient. For many people with arteries narrowed less than 50 percent, medication is prescribed to help reduce the risk of ischemic stroke. These include antihypertensives to control high blood pressure, medications to reduce cholesterol levels, and anticoagulants to thin blood and prevent it from clotting.

Surgery

Carotid endarterectomy is a procedure in which the neurosurgeon makes an incision in the carotid artery and removes the plaque using a dissecting tool. Removing the plaque is accomplished by widening the passageway, which helps to restore normal blood flow. The artery will be repaired with sutures or a graft. The entire procedure usually takes about two hours. The patient may experience pain near the incision in the neck and some difficulty swallowing during the first few days after surgery. Most patients are able to go home after one or two days and return to work, usually within a month. Avoid driving and limit physical activities for a few weeks after surgery.

Carotid Angioplasty and Stenting

An alternative, new form of treatment, carotid angioplasty and stenting, shows some promise in patients who may be at too high risk to undergo surgery. Carotid stenting is a procedure in which a tiny, slender metal-mesh tube is fitted inside your carotid artery to increase the flow of blood blocked by plaques. The stent is inserted following a procedure called angioplasty, in which the doctor guides a balloon-tipped catheter into the blocked artery. The balloon is inflated and pressed against the plaque, flattening it and re-opening the artery. The stent acts as scaffolding to prevent the artery from collapsing or from closing up again after the procedure is completed.

Cerebral Aneurysms

A cerebral (or cranial) aneurysm is an area where a blood vessel in the brain weakens, resulting in a bulging or ballooning out of part of the vessel wall. Usually, aneurysms develop at the point where a blood vessel branches, because the "fork" is structurally more vulnerable. The disorder may result from congenital defects or from other conditions such as high blood pressure, atherosclerosis (the buildup of fatty deposits in the arteries) or head trauma.

Aneurysms occur in all age groups, but the incidence increases steadily for individuals age 25 and older, is most prevalent in people ages 50 to 60 and is about three times more prevalent in women. The outcome for patients treated before a ruptured aneurysm is much better than for those treated after, so the need for adequate evaluation of patients suspected of having a cerebral aneurysm is very important.

Unruptured cerebral aneurysms can be detected by noninvasive measures, including MRA and a carotid angiogram. A rupture can be detected by a CT scan or lumbar puncture. If these tests suggest the presence of an aneurysm, formal cerebral angiography may be performed.

People who suffer a ruptured brain aneurysm may have some or all of these warning signs: localized headache, nausea and vomiting, stiff neck, blurred or double vision, sensitivity to light (photophobia), or loss of sensation. Many people with unruptured brain aneurysms have no symptoms. Others might experience some or all of the following symptoms, which may be possible signs of an aneurysm: cranial nerve palsy, dilated pupils, double vision, pain above and behind eye and localized headache.

When cerebral aneurysms rupture, they usually cause bleeding in the brain, resulting in a subarachnoid hemorrhage. Blood can also leak into the cerebrospinal fluid (CSF) or areas surrounding the brain and cause an intracranial hematoma (a blood clot). Blood can irritate, damage or destroy nearby brain cells. This may cause problems with bodily functions or mental skills. In more serious cases, the bleeding may cause brain damage, paralysis or coma. Ruptured brain aneurysms are fatal in about 50 percent of cases.

Surgery

An operation to "clip" the aneurysm is performed by doing a craniotomy (opening the skull surgically), and isolating the aneurysm from the bloodstream using one or more clips, which allows it to deflate. Surgical repair of cerebral aneurysms is not possible if they are located in unreachable parts of the brain. Angiography is used to visualize closure of the aneurysm and preserve normal flow of blood in the brain.

A less invasive technique which does not require an operation, called endovascular therapy, uses micro catheters to deliver coils to the site of the enlarged blood vessel that occludes (closes up) the aneurysm from inside the blood vessel. A procedure called balloon assisted coiling uses a tiny balloon catheter to help hold the coil in place. A procedure called combination stent and coiling utilizes a small flexible cylindrical mesh tube that provides a scaffold for the coiling. Aneurysms may be treated with endovascular techniques when the risk of surgery is too high.

While the best method of securing the aneurysm should be made on an individual basis, in general, patients with a ruptured cerebral aneurysm should be treated as soon as possible. Surgical risks and outcomes depend on whether or not the aneurysm has ruptured, the size and location of the aneurysm and the patient's age and overall health.

Postsurgical complications can include vasospasm and hydrocephalus. Vasospasm is a sudden constriction of a blood vessel that reduces the blood flow. Hydrocephalus is a condition in which excess cerebrospinal fluid (CSF) builds up within the ventricles (fluid-containing cavities) of the brain and may increase pressure within the head.

Vascular Malformations

The term vascular malformation refers to an abnormal connection of an artery, vein or both. These include malformations of normal veins or arteries leading directly to veins. Vascular malformations are formed as the blood vessels in the brain develop during pregnancy, but the direct cause is unknown.

Arteriovenous malformations (AVMs)

An AVM is a tangle of abnormal and poorly formed blood vessels (arteries and veins), with a higher rate of bleeding than normal vessels. AVMs can occur anywhere in the body, but brain AVMs present substantial risks when they bleed. Dural AVMs occur in the covering of the brain, and are an acquired disorder that may be triggered by an injury.

AVMs are usually diagnosed through a combination of MRI and angiography. AVMs can irritate the surrounding brain and cause seizures or headaches. Left untreated, AVMs can enlarge and rupture, causing intracerebral or subarachnoid hemorrhage and permanent brain damage. Every year, about four out of every 100 people with an AVM will experience a hemorrhage. Preventing the rupture of vascular malformations is one of the major reasons that early neurosurgical treatment is recommended for AVMs.

A treatment plan is devised to offer the lowest risk, yet highest chance of obliterating the lesion. The three types of treatment available include direct removal using microsurgical techniques, stereotactic radiosurgery and embolization using neuroendovascular techniques. Although microsurgical treatment affords the opportunity for immediate removal of the AVM, some AVMs may best be treated by a combination of therapies.

Stereotactic radiosurgery is a minimally invasive treatment that uses computer guidance to concentrate radiation to the malformed vessels of the brain. This radiation causes abnormal vessels to close off. Unfortunately, stereotactic radiosurgery is usually limited to lesions less than 3.5 cm in diameter and may take up to two years to completely obliterate the lesion.

Embolization uses neuroendovascular techniques to guide tiny catheters into the small cerebral vessels of the brain that feed the AVM. Once the catheter reaches the core of the AVM, liquid glue or particles can be injected to occlude portions of the AVM or its feeding arteries. Neuroendovascular therapy can make subsequent surgical removal of an AVM safer or can reduce the size of an AVM to a volume in which radiosurgery offers a higher efficacy.

Moyamoya disease

Moyamoya disease is a progressive disease of the carotid arteries and their major branches that can lead to irreversible blockage. The name comes from the Japanese word for a "puff of smoke" due to the appearance of the lesions that form. In fact, it affects people of Japanese origin far more commonly than the rest of the population. It is a disease that tends to affect children and adults in the third to fourth decades of life. Children with the disease may have strokes, TIAs, slowly progressive cognitive decline, seizures or involuntary movements of the extremities. Adults more commonly experience intracranial hemorrhages as a result of the disease.

There are several surgeries that have been developed for the condition, but currently the most favored are EDAS, EMS, STA-MCA and multiple burr holes.

The EDAS (encephaloduroarteriosynangiosis) procedure requires dissecting a scalp artery over a length of several inches and then making a small temporary opening in the skull directly beneath the artery. The artery is then sutured to the surface of the brain and the bone replaced.

In EMS (encephalomyosynangiosis) surgery, the temporalis muscle, which is in the temple region of the forehead, is dissected and through an opening in the skull, placed onto the surface of the brain.

Other operations include the STA-MCA (superficial temporal artery-middle cerebral artery), in which a scalp artery is directly sutured to a brain surface artery, and a procedure in which multiple small holes (burr holes) are placed in the skull to allow for growth of new vessels into the brain from the scalp.

Venous angiomas

Patients with venous angiomas may have headaches or seizures, although these symptoms may be unrelated to the angiomas. More commonly, these lesions are asymptomatic and are identified when patients are being evaluated for other conditions. They rarely bleed, so treatment is usually not necessary. They affect approximately 2 percent of the general population.

Vein of Galen malformation (VGM)

A far rarer malformation is the VGM, sometimes detected in prenatal testing, or through heart failure in infants. Occurring during embryonic development, a VGM is an abnormal connection between arteries and the deep draining veins of the brain. Under normal conditions, these arteries and veins are connected by capillaries that function to slow blood flow through the brain, allowing for the necessary exchange of oxygen and nutrients.

A VGM has a thicker wall than an AVM and is unlikely to rupture and bleed. However, because a VGM does not have capillaries, the blood may flow extremely fast, putting excessive strain on the heart, which may result in cardiac failure. It is very important that children suffering from this condition be evaluated and diagnosed by experts so that appropriate treatment measures are taken. Embolization is the method of choice for treating patients with VGMs.

Glossary

Aneurysm – An abnormal, balloon-like bulging of the wall of an artery.

Angiogram – A study which shows the blood vessels leading to and in the brain by injecting a dye or contrast substance through a catheter placed in the artery of the leg.

Angiography – Radiography of blood vessels using the injection of material opaque to X-rays, to better define the vessels.

Anticoagulant – Any medicine that keeps blood from clotting; a blood thinner.

Antihypertensive – Any medicine or other therapy that lowers blood pressure.

Arachnoid – Middle layer of membranes covering the brain and spinal cord.

Arteriovenous – Relating to both arteries and veins.

Artery – A blood vessel that carries blood away from the heart to the body.

Atherosclerosis – A disease process that leads to the buildup of fat and cholesterol, called plaque, inside blood vessels.

Brain attack – Another name for stroke.

Bruit – A sound made in the blood vessels resulting from turbulence, perhaps due to a buildup of plaque or damage to the vessels.

Carotid artery – A major artery on the right and left side of the neck supplying blood to the brain.

Cerebral embolism – A blood clot from one part of the body that is carried by the bloodstream to the brain, where it blocks an artery.

Cerebral hemorrhage – Bleeding within the brain resulting from a ruptured blood vessel, aneurysm or head injury.

Cerebral infarction – A stroke caused by interruption or blockage of blood flow to the brain; also called ischemic stroke.

Cerebral thrombosis – Formation of a blood clot in an artery that supplies blood to part of the brain.

Cerebrovascular – Pertaining to the brain and the blood vessels that supply it.

Cerebrovascular occlusion – The blocking or closing up of a blood vessel in the brain.

Endarterectomy – Removal of fatty or cholesterol plaques and calcified deposits from the internal wall of an artery.

Endovascular – Pertaining to a surgical procedure in which a catheter containing medications or miniature instruments is inserted through the skin into a blood vessel for the treatment of vascular disease.

Hydrocephalus – a condition in which excess cerebrospinal fluid (CSF) builds up within the ventricles (fluid-containing cavities) of the brain and may increase pressure within the head.

Ischemia – Inadequate circulation of blood generally due to a blockage of an artery.

Ischemic stroke – A stroke caused by interruption or blockage of blood flow to the brain.

Jugular veins – The veins that carry blood back from the head to the heart.

Plaque – A deposit of fatty (and other) substances in the inner lining of the artery wall, which usually leads to atherosclerosis.

Stent – A device made of expandable, metal mesh that is placed (by using a balloon catheter) at the site of a narrowing artery. The stent is then expanded and left in place to keep the artery open.

Subarachnoid hemorrhage – Blood in, or bleeding into, the space under the arachnoid membrane, most commonly from trauma or from rupture of an aneurysm.

Transient ischemic attack (TIA) – A temporary interruption of the blood supply to an area of the brain; also called a mini-stroke. It usually lasts only a few minutes and causes no permanent damage or disability.

Vasospasm – Spasm of blood vessels which decreases their diameter.

The AANS does not endorse any treatments, procedures, products or physicians referenced in these patient fact sheets. This information is provided as an educational service and is not intended to serve as medical advice. Anyone seeking specific neurosurgical advice or assistance should consult his or her neurosurgeon, or locate one in your area through the AANS' Find a Board-certified Neurosurgeon™ online tool.