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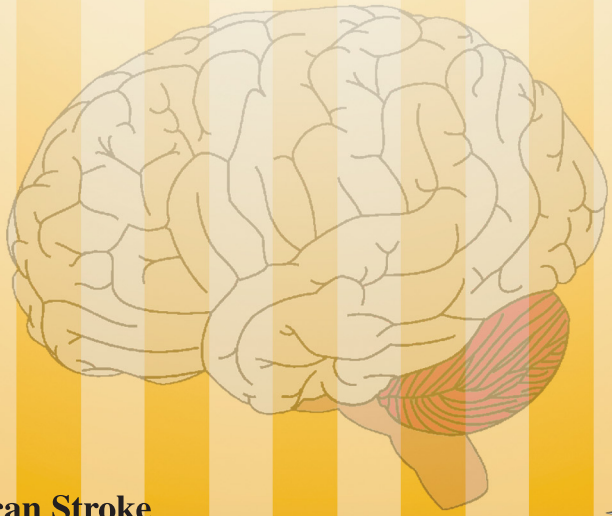
What You Should Know About Cerebral Aneurysms

From the Cerebrovascular Imaging and Intervention Committee of the American Heart Association Cardiovascular Council

Randall T. Higashida, M.D., Chair



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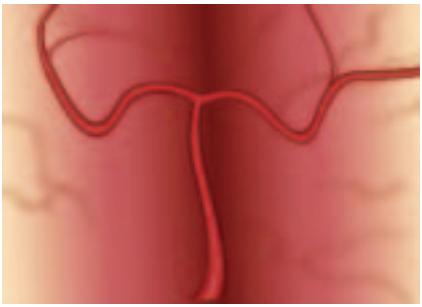
What is a cerebral aneurysm?

An aneurysm is a weak area in a blood vessel that usually enlarges. It's often described as a "ballooning" out of the blood vessel.



Normal vessels

How common are aneurysms?

It is estimated that 1.5–5 percent of the general population has or will develop a cerebral aneurysm. It is also estimated that 3–5 million people in the United States have cerebral aneurysms, but most are not producing any symptoms. Annually, between 0.5–3 percent of people with a brain aneurysm may suffer from bleeding.

How do aneurysms form? Are people born with an aneurysm?

Cerebral aneurysm

Usually, people are not born with them. Most develop after the age of 40. Aneurysms usually develop at branching points of arteries and are caused by constant pressure from blood flow. They often enlarge slowly and become weaker as they grow, just as a balloon becomes weaker as it stretches. Aneurysms may be associated with other types of blood vessel disorders, such as fibromuscular dysplasia, cerebral arteritis or arterial dissection, but these are very unusual. They may run in families, but people are rarely born with a predisposition for aneurysms. Some aneurysms are due to infections, drugs such as amphetamines and cocaine that damage the brain's blood vessels, or direct brain trauma from an accident.

Are all aneurysms the same?

Brain aneurysms are all different. They vary in size, shape and location.

Size

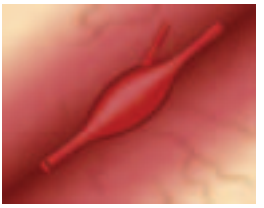
- Small aneurysms are less than 5 mm (1/4 inch).
- Medium aneurysms are 6–15 mm (1/4 to 3/4 inch).
- Large aneurysms are 16–25 mm (3/4 to 1 1/4 inch).
- Giant aneurysms are larger than 25 mm (1 1/4 inch).

Shape

Aneurysms can be:

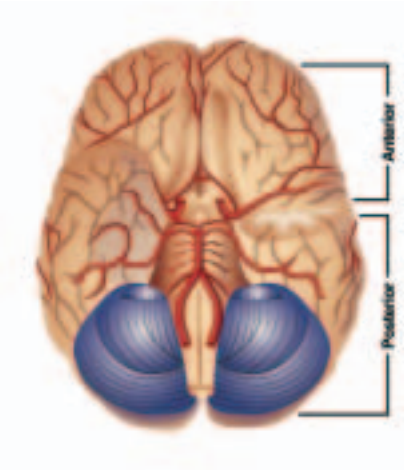
Saccular (sac-like), with a well-defined neck.

Broad-based with a wide neck



Fusiform (spindle shaped) without a distinct neck.

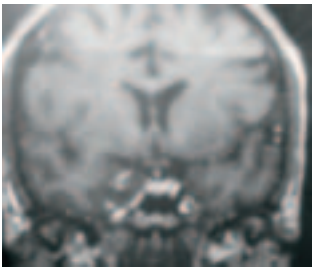
Location



An aneurysm is usually located along the major arteries deep within brain structures. When approaching an aneurysm during surgery, normal brain tissue must be carefully spread apart to expose it. Aneurysms can occur in the front part of the brain (anterior circulation) or the back part of the brain (posterior circulation).

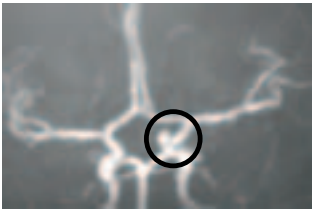
How is an aneurysm diagnosed?

A brain aneurysm needs to be detected by special imaging tests. Two non-invasive tests show the blood vessels in the brain. In the first, called CTA (Computed Tomographic Angiography), patients are placed on a table that slides into a CT scanner. A special contrast material (dye) is injected into a vein and images are taken of the blood vessels to look for abnormalities such as an aneurysm.



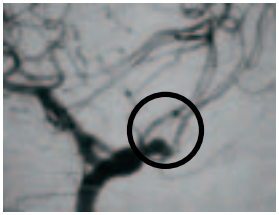
Magnetic resonance image of normal brain tissue.

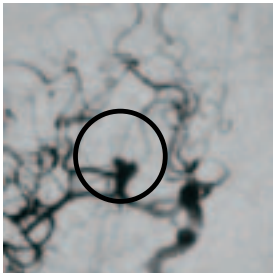
In the second test, called an MRA (Magnetic Resonance Angiography), patients are placed on a table that slides into a magnetic resonance scanner, and the blood vessels are imaged to detect a cerebral aneurysm. Both of these screening tests are useful to detect most cerebral aneurysms larger than 3–5 mm (about 3/16 inch).



Magnetic resonance angiogram of a small brain aneurysm.

The most reliable test is called a diagnostic cerebral angiogram. In this test, the patient lies on an X-ray table. A small tube (catheter) is inserted through a blood vessel in the leg and guided into each of the blood vessels in the neck that go to the brain. Contrast material (dye) is then injected, and pictures are taken of all of the blood vessels in the brain. This test is slightly more invasive and less comfortable, but it is the most reliable way to detect all types and sizes of cerebral aneurysms.





Above: Two cerebral angiogram images showing brain aneurysms.

Before *any* treatment is considered, a diagnostic cerebral angiogram is usually performed in order to fully map a plan for therapy.

If one aneurysm forms, will others form?

The presence of one aneurysm is associated with a 15–20 percent chance of having at least one or multiple other aneurysms.

What are the symptoms of an unruptured aneurysm?

Most smaller aneurysms have no symptom. As an aneurysm enlarges, however, it can produce headaches or localized pain. If an aneurysm gets very large, it may produce pressure on the normal brain tissue or adjacent nerves. This pressure can cause difficulty with vision, numbness or weakness of an arm or leg, difficulty with memory or speech, or seizures.

What causes an aneurysm to bleed?

We usually don't know why an aneurysm bleeds or exactly when it will bleed. We do know what increases the chance for bleeding:

- High blood pressure, often due to heavy lifting or straining, is one possibility.
- Strong emotions, as when people become upset or angry, can also cause aneurysms to rupture.
- Blood "thinners" (such as warfarin), some medications and prescription drugs (including diet pills that act as stimulants such as ephedrine and amphetamines), and harmful drugs like cocaine can cause aneurysms to rupture and bleed.

Ruptured aneurysm

What are the chances that an unruptured aneurysm may bleed?

Many factors determine whether an aneurysm is likely to bleed. These include the size, shape and location of the aneurysm and symptoms that it causes. Smaller aneurysms that are uniform in size may be less likely to bleed than larger, irregularly shaped aneurysms. Once an aneurysm has bled, there is a very high chance of re-bleeding. That is why treatment as soon as possible is recommended.

What happens if an aneurysm bleeds?

If an aneurysm ruptures, it leaks blood into the space around the brain. This is called a "subarachnoid hemorrhage." Depending upon the amount of blood, it can produce:

- a sudden severe headache that can last from several hours to days
- nausea and vomiting
- drowsiness and/or coma.

The hemorrhage may also damage the brain directly, usually from bleeding into the brain itself. This is called a " hemorrhagic stroke" This can lead to

- weakness or paralysis of an arm or leg
- trouble speaking or understanding language
- vision problems
- seizures

What is the usual damage to the brain after an aneurysm bleeds?

Once an aneurysm bleeds, there is a 30–40 percent chance of death, and a 20–35 percent chance of moderate to severe brain damage, even if the aneurysm is treated. 15–30 percent of patients have only mild difficulties or almost none. If the aneurysm is not treated quickly enough, another bleed may occur from the already ruptured aneurysm.

In 15–20 percent of patients, vasospasm (irritation by the leaked blood causing narrowing of the blood vessels) may occur. This can lead to further brain damage. Other problems may include hydrocephalus (enlargement of the spaces within the brain that produce cerebrospinal fluid); difficulty breathing that requires a mechanical ventilator, and infection. Heart and lung problems may result due to extensive brain damage that can affect the body's normal functions.

Why is the damage so extensive after bleeding?

Once blood enters the brain and the space around it, direct damage to the brain tissue and brain function results. This amount of damage is usually related to the amount of blood. Damage is due to the increased pressure and swelling from bleeding directly into the brain tissue, or from local cellular damage to brain tissue from irritation of blood in the space between the brain and the skull.

Blood can also irritate and damage the normal blood vessels and cause vasospasm (constriction). This can interrupt normal blood flow to the healthy brain tissue and can cause even more brain damage.

Will treating a ruptured aneurysm reverse or improve brain damage?

Once an aneurysm bleeds and brain damage occurs, treating the aneurysm will not reverse the damage. Treatment is necessary, but the treatment only helps prevent more bleeding, which can cause more damage to the brain and, consequently, to the body's functions.

If bleeding has already caused brain damage, patients may benefit from rehabilitation therapy once the aneurysm has been treated.

How is a treatment method for aneurysm chosen?

Each patient and each aneurysm is different. Doctors must evaluate the risk factors that favor treatment vs. non-treatment and must decide which technique may be best.

It is important to consult with experts in this field. This should include a discussion with a cerebrovascular neurosurgeon who specializes in surgically clipping aneurysms **and** an interventional neuroradiologist/endovascular surgeon who specializes in the less invasive treatment of cerebral aneurysms by coiling. These 2 types of medical specialists are

usually different, and have different expertise and training backgrounds. It is highly recommended to have a consultation with both types of physicians.

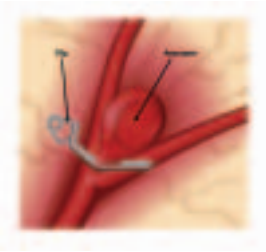
How should an aneurysm be treated?

The best treatment depends upon many things, including whether the aneurysm has ruptured or not. A ruptured aneurysm usually requires treatment right away, because the re-bleeding rate remains quite high. However, the treatment time and options for treatment depend upon the size, location and shape of the aneurysm, as well as the patient's overall medical condition.

If an aneurysm has not ruptured, the treatment decision depends upon its size, location and shape, and the patient's symptoms. Each factor is important and requires consultation with a neurosurgeon and an interventional neuroradiologist who has special skills and training in treating these types of aneurysms.

What treatments are available?

- **Medical therapy.** Small, unruptured aneurysms that are not creating any symptoms may not need treatment unless they grow, trigger symptoms or rupture. It is very important to have annual check-ups to monitor blood pressure, cholesterol, and other medical conditions. Small, unruptured aneurysms require regular imaging examinations to make sure that they have not grown or changed significantly.



Surgical clipping of an aneurysm

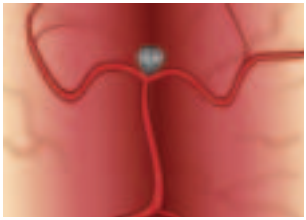
- **Neurosurgery.** Depending upon an individual's risk factors, open surgery may be recommended. Patients are placed under general anesthesia, an opening is made in the skull, the brain tissue is spread apart and the aneurysm is surgically exposed. Then the neurosurgeon places a surgical clip around its base. The clip seals off the aneurysm so blood cannot enter. For an uncomplicated surgical clipping procedure, the hospital stay is usually 4–6 days. Recovery after the operation takes 3–6 weeks.

- **Interventional neuroradiology/endovascular neurosurgery.** Depending upon the aneurysm's size, location and shape, it may be possible to treat the aneurysm from inside the blood vessel. This minimally invasive procedure is similar to the cerebral angiogram. However, in addition to taking pictures, a small tube (catheter) is directed

through the blood vessels into the aneurysm itself.

Then, using X-ray guidance, the endovascular surgeon carefully places soft platinum micro-coils into the aneurysm and detaches them. The coils stay within the aneurysm and act as a mechanical barrier to blood flow, thus sealing it off. For an uncomplicated procedure, the hospital stay usually lasts 1–2 days. Recovery after the operation usually takes 5–7 days.

For a complicated surgery or endovascular treatment, or if an aneurysm has bled into the brain, hospitalization may be for 1–4 weeks, depending upon the patient's medical condition and any complications caused by the hemorrhage.



Endovascular coiling of a cerebral aneurysm

What are the potential complications of aneurysm treatment?

Until the aneurysm is safely and completely treated, there is always the risk it may re-bleed and cause more brain damage. If normal blood vessels are damaged, it could also result in more brain damage. This could cause weakness or paralysis of the arm or leg, difficulty with speech or understanding, vision loss, confusion, loss of memory and/or seizures. There is also the risk of the anesthesia itself, infection, bleeding, damage to the kidneys from the X-ray dye and other potential problems.

All these risks need to be carefully considered when deciding upon a course of treatment. There are risks if the aneurysm is not treated. The aneurysm may bleed or grow in size.

What follow-up is required after aneurysm treatment?

There are two follow-up procedures depending on the type of treatment:

- **Surgical clipping.** After this type of surgery, a post-operative angiogram is usually performed during the hospital stay to make sure the surgical clip has completely treated the aneurysm.

- **Interventional neuroradiology/endovascular neurosurgery.** After coiling an aneurysm, a routine follow-up angiogram is usually performed 6–12 months after the procedure to make sure the aneurysm remains blocked off. In some cases, particularly with larger aneurysms, further coil treatment may be needed to make sure the aneurysm is no longer at risk.

About Strokes and Cerebrovascular Diseases

Stroke and cerebrovascular diseases are the third-leading cause of death and a leading cause of major disability in the United States. More than 700,000 new and recurrent strokes occur each year, resulting in about 167,000 deaths and more than 250,000 permanent disabilities per year in the United States. More than 4.7 million stroke survivors are alive today.

Hemorrhagic strokes are caused by bleeding into the brain, causing either death or major disability. Cerebral aneurysm ruptures account for the majority of these hemorrhagic strokes each year.

About ISAT

International Subarachnoid Aneurysm Trial (ISAT)

What is ISAT?

The INTERNATIONAL SUBARACHNOID ANEURYSM TRIAL, or **ISAT** is the only multi center prospective randomized trial that compares surgical clipping with endovascular coiling for the treatment of ruptured intracranial aneurysms. This means that patients with aneurysms that could be treated by either surgery or coiling were enrolled and randomly assigned to receive one of these two treatments. They were then followed to see how they recovered. Published in the British Medical Journal, The Lancet, the study concluded that "**in patients with a ruptured intracranial aneurysm, for which endovascular coiling and neurosurgical clipping are therapeutic options, the outcomes in terms of survival free of disability at 1 year is significantly better with endovascular coiling**."[1]

Which kind of patients suffering from an aneurysm were treated in ISAT?

ISAT's primary criteria for enrollment was that a patient with a ruptured aneurysm who was treated at one of the trial centers had to be judged equally suitable for either surgical or endovascular therapy by the treating physician. The trial was designed to show whether a policy of endovascular treatment would reduce the percentage of patients with poor or moderate outcomes at one year post treatment compared to a policy of surgical treatment. The trial protocol was peer reviewed and approved by the Medical Research Council of the United Kingdom.

How many patients were enrolled in ISAT and what does the data mean?

On May 2, 2002, after enrolling 2143 of the planned 2,500 patients, ISAT halted patient enrollment into the trial following a planned data review by the Data Monitoring Committee that found that the trial had reached its primary endpoint and that it was no longer ethical to randomize patients to neurosurgery with clipping. Although enrollment ended, data analysis and patient follow-up still continues.

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[1]Molyneux, Andrew, et.al., "International Subarachnoid Aneurysm Trial (ISAT) of neurosurgical clipping versus endovascular coiling in 2143 patients with ruptured intracranial aneurysms: a randomised trial." THE LANCET Saturday 26, October 2002 Vol. 360 No. 9342 Pages 1267-1274

How can I find more date about ISAT?

On October 26, 2002, The Lancet (www.thelancet.com) published the ISAT findings. The article was reprinted in the November-December issue of the Journal of Stroke and Cerebrovascular Disease. For the 1594 patients with one-year post treatment outcomes, the relative risk of dependence or death for patients assigned to endovascular therapy was ***22.6% lower*** than that of patients assigned to surgical therapy with an absolute risk reduction of 6.9%. The study concluded that "in patients with a ruptured intracranial aneurysm, for which endovascular coiling and neurosurgical clipping are therapeutic options, the outcomes in terms of survival free of disability at 1 year is significantly better with endovascular coiling." The risk of rebleeding after one year was low for both procedures- two per 1276 patient years for endovascular therapy and zero per 1081 patient years for surgery.

Will there be additional data coming out of this trial?

Begun in 1994 with a pilot study and commencing full enrollment in 1997, ISAT involved 43 centers in the UK, Europe, Australia, and North America. The trial was funded by the Medical Research Council (UK), French Ministry of Health, Assistance Publique, Hopitaux de Paris, Canadian Institutes of Health Research, and the Stroke Association of the UK. ISAT will continue to publish data and findings through 2007. Among the issues that ISAT will address are long-term risk of rebleeding, neuropsychological outcomes, quality of life and health economic results.

What people are saying about ISAT?
"Patients with an aneurysm really need to be evaluated in a center that offers both kinds of treatment, in a truly unbiased setting where their aneurysm is evaluated by experts." (*Associated Press)*

For more information, contact the American Stroke Association, a division of the American Heart Association, at 1-888-4-STROKE (1-888-478-7653) or visit StrokeAssociation.org.

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