

Unruptured Aneurysms basic level

Overview

An aneurysm is a balloon-like bulge or weakening of an arterial wall. As an aneurysm enlarges it puts pressure on surrounding structures, causing headache or vision problems, and may eventually rupture. The rupturing of an aneurysm releases blood into the spaces around the brain causing a subarachnoid hemorrhage (SAH), a type of stroke and a life-threatening situation. Treatment options for aneurysms include observation, surgical clipping, coiling, and bypass.

Blood supply of the brain

To understand aneurysms, it is helpful to understand the circulatory system of the brain (see Anatomy of the Brain). Blood is carried to the brain by two paired arteries, the internal carotid arteries and the vertebral arteries (Fig. 1). The internal carotid arteries supply the anterior (front) areas and the vertebral arteries supply the posterior (back) areas of the brain. After passing through the skull, the right and left vertebral arteries join together to form a single basilar artery. The basilar artery and the internal carotid arteries communicate with each other in a ring at the base of the brain called the Circle of Willis.

What is an aneurysm?

An aneurysm is a balloon-like bulge or weakening of an arterial wall. As this bulge grows it becomes thinner and weaker. It can become so thin that the blood pressure within it can cause it to burst or leak. Most aneurysms develop from a weakness or abnormal artery wall. Aneurysms usually occurs on larger blood vessels where an artery branches. Approximately 80% of aneurysms form in the front (anterior circulation) of the brain, while 20% form in the back (posterior circulation) of the brain. Types of aneurysms include (Fig. 2):

- **Saccular** - (most common, also called "berry") the aneurysm bulges from one side of the artery and has a distinct neck at its base.
- **Fusiform** - the aneurysm bulges in all directions and has no distinct neck.
- **Giant** - may be saccular or fusiform and measures more than 2.5 cm in diameter; the neck is often wide and may involve more than one artery.
- **Traumatic** – caused by a closed head injury or penetrating trauma.

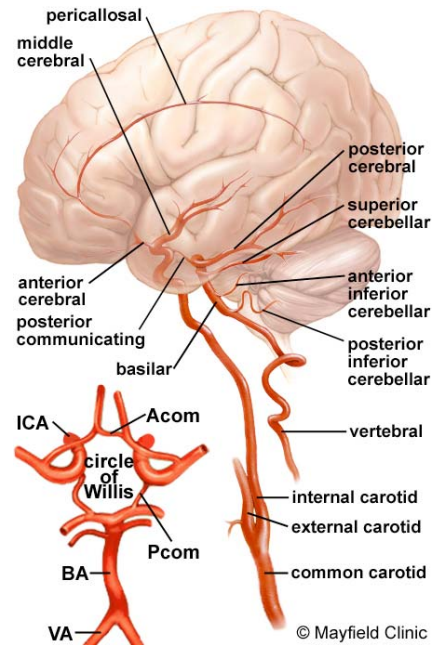


Figure 1. (side view) Blood supply of the brain.

Frequent aneurysm locations:	
Internal carotid artery	36%
Middle cerebral artery	33%
Anterior cerebral artery	15%
Basilar artery	6%
Vertebral basilar	4%
Posterior communicating artery	4%
Cavernous carotid artery	2%

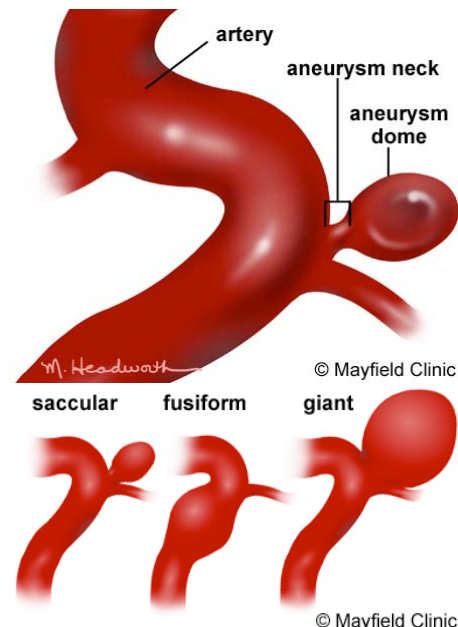


Figure 2. Anatomy of an aneurysm (above). Different types of aneurysms (below).

What are the symptoms?

Most aneurysms don't have symptoms (asymptomatic) until they rupture. Ruptured aneurysms release blood into the spaces around the brain called a subarachnoid hemorrhage (SAH). Unruptured aneurysms rarely show symptoms until they grow large or press on vital structures. Rupture usually occurs while a person is active rather than asleep. If you experience the symptoms of a SAH, call 911 immediately!

Symptoms of a ruptured aneurysm (SAH)

- Sudden onset of a severe headache (described as "worst headache of my life")
- Nausea and vomiting
- Stiff neck
- Transient loss of vision or consciousness

Symptoms of an unruptured aneurysm

- Double vision
- Dilated pupils
- Pain above and behind the eye
- Newly unexplained headaches (rare)

Who is affected?

Approximately 5% of the population may have or develop an aneurysm; of those, 20% have multiple aneurysms. Unruptured aneurysms are more common (2.7 million per year) than ruptured (20,000 per year) (1). However, 85% of aneurysms are not diagnosed until after they rupture. Aneurysms are usually diagnosed between ages 35 to 60 and are more common in women.

Studies have shown a strong link to family history (2). If an immediate family member has suffered an aneurysm, you are 4 times more likely to have one as well. The genetic link is not completely understood and studies are underway to determine if there is a pattern of inheritance. The most important inherited conditions associated with aneurysms include Ehlers-Danlos IV, Marfan's syndrome, neurofibromatosis NF1, and polycystic kidney disease. For those with a strong family history, we recommend a screening test (CT or MR angiogram).

How is a diagnosis made?

Most people find out they have an unruptured aneurysm by chance (incidental) during a scan for some other medical problem. If you are experiencing symptoms and your primary care doctor suspects an aneurysm, you may be referred to a neurosurgeon. The doctor will learn as much about your symptoms, current and previous medical problems, current medications, family history, and perform a physical exam. Diagnostic tests are used to help determine the aneurysm's location, size, type, and involvement with other structures.

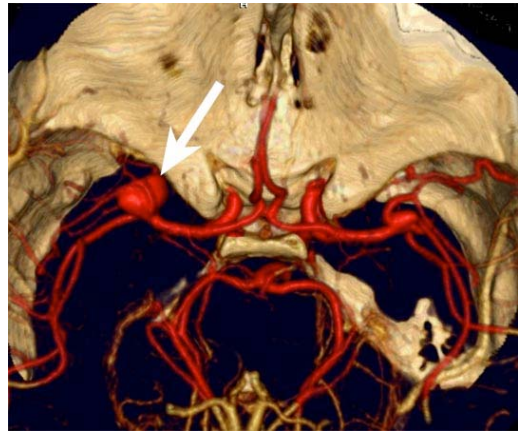


Figure 3. A CT angiogram shows an aneurysm on the left (arrow) middle cerebral artery.

Computed Tomography Angiography (CTA) is a noninvasive X-ray to review the anatomical structures within the brain to detect blood in or around the brain. A newer technology called CT angiography involves the injection of contrast into the blood stream to view the arteries of the brain. This type of test provides the best pictures of blood vessels through angiography and soft tissues through CT (Fig. 3).

Angiogram is an invasive procedure, where a catheter is inserted into an artery and passed through the blood vessels to the brain. Once the catheter is in place, a contrast dye is injected into the bloodstream and the x-ray images are taken.

Magnetic Resonance Angiography (MRA) is a noninvasive test, which uses a magnetic field and radio-frequency waves to give a detailed view of the soft tissues of your brain. An MRA (Magnetic Resonance Angiogram) is the same non-invasive study, except it is also an angiogram, which means it also examines the blood vessels, as well as the structures of the brain.

Should the aneurysm be treated?

Deciding how, or even if, to treat an unruptured aneurysm involves weighing the risks of rupture versus the risks of treatment.

Risk of rupture

The risk of aneurysm rupture is about 1% but may be higher or lower depending on the size and location of the aneurysm; however, when a rupture occurs there is a 50% risk of death. Risk factors for rupture include smoking, high blood pressure, alcohol, genetic factors (family inherited), atherosclerosis (hardening of the arteries), oral contraceptives, and lifestyle (3). Other factors such as the size and location of the aneurysm, overall health of the patient, and medical history must also be considered. Generally, the larger the aneurysm, the higher risk of rupture. Also, aneurysms in the posterior circulation (basilar, vertebral and posterior

communicating arteries) have a higher risk of rupture. The neurosurgeon will discuss with you all the options and recommend a treatment that is best for your individual case.

What treatments are available?

Observation

Sometimes the best treatment may be to simply watch and reduce your risk of rupture (quit smoking, control high blood pressure). Aneurysms that are small, unruptured, and asymptomatic may be observed with imaging scans every year until the growth or symptoms necessitate surgery. Observation may be the best option for patients with other health conditions.

Surgical clipping

The most common treatment for an aneurysm is direct surgical clipping. Using general anesthesia, an opening is made in the skull, called a craniotomy. The brain is gently retracted so that the artery with the aneurysm may be located. A small clip is placed across the neck of the aneurysm to block the normal blood flow from entering the aneurysm (Fig. 4). The clip is made of titanium and remains on the artery permanently.

Artery occlusion and bypass

If surgical clipping is not possible or the artery is too damaged, the surgeon may completely block (occlude) the artery that has the aneurysm. The blood flow is detoured (bypassed) around the occluded section of artery by inserting a graft (Fig. 5). The graft is a small artery, usually taken from your scalp, which is sewn into place above and below the blocked section.

A bypass graft can also be created from a different artery that is rerouted from its normal position (usually from the side of your head) passed through a hole in the skull, and sewn into place above the blocked artery. Surgeons call this procedure a Superficial Temporal Artery - Middle Cerebral Artery bypass, or STA-MCA bypass for short.

Endovascular coiling

In contrast to surgery, another form of treatment is endovascular coiling. This is performed in the angiography suites of the Radiology Department by a Neuro Interventionalist and sometimes requires general anesthesia. In a coiling procedure, a catheter is inserted into an artery in the groin and then passed through the blood vessels to the aneurysm. The doctor guides the catheter through the bloodstream while watching a fluoroscopy (a type of x-ray) monitor. Through the catheter, the aneurysm is packed with material, either platinum coils or balloons, that prevents blood flow into the aneurysm (Fig. 6). Since coiling is a relatively new procedure, follow-up angiograms are performed periodically to confirm the aneurysm is still occluded and not growing larger.

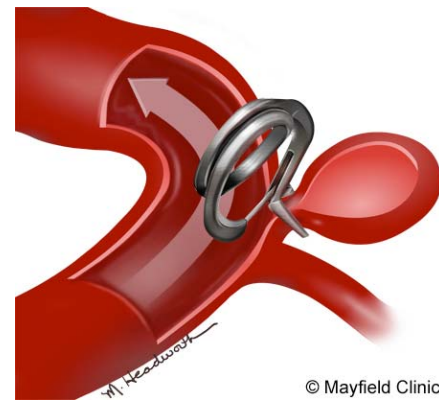


Figure 4. A titanium clip is placed across the neck of an aneurysm.

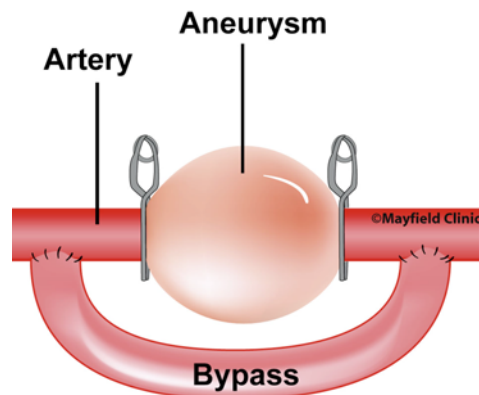


Figure 5. The aneurysm is blocked off between two clips and a bypass is sewn to detour blood flow around the aneurysm.

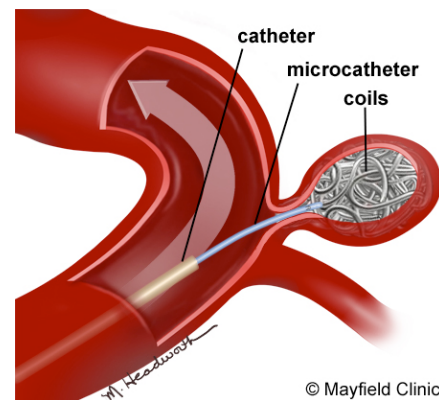


Figure 6. The aneurysm is packed with platinum coils by way of a small catheter.

Clinical trials

Clinical trials are research studies in which new treatments—drugs, diagnostics, procedures, vaccines, and other therapies—are tested in people to see if they are safe and effective. Research is always being conducted to improve the standard of medical care and explore new drug and surgical

treatments. You can find information about current clinical investigations, including their eligibility requirements, protocol, and participating locations on the web: the National Institutes of Health (NIH) at clinicaltrials.gov, sponsors many trials; private industry and pharmaceutical companies also sponsor trials www.centerwatch.com.

Recovery & prevention

Unruptured aneurysm patients recover from surgery or endovascular treatment much faster than those who suffer a SAH. The possibility of having a second bleed increases to 50% within the first 14 days after the first bleed. This is why neurosurgeons prefer to do direct surgical or endovascular treatment as soon as the aneurysm is diagnosed, so that the risk of a re-bleed is lessened.

Aneurysm patients may suffer short-term and/or long-term deficits as a result of a treatment or rupture. Some of these deficits may disappear over time with healing and therapy.

Sources & links

If you have more questions, please contact the Mayfield Clinic at 800-325-7787 or 513-221-1100. For information about the University of Cincinnati Neuroscience Institute's Neurovascular Center, call 866-941-8264.

Links

The Brain Aneurysm Foundation
www.bafound.org or 617-723-3870

www.brainaneurysm.com

Tri-State Brain Aneurysm Support Group
www.tsbaconnex.org

Sources

1. Wiebers DO: Unruptured intracranial aneurysms – risk of rupture and risks of surgical intervention. *N Engl J Med* 339:1725-33, 1998.
2. Leblanc R: Familial Cerebral Aneurysms. *Canadian Journal of Neurological Sciences* 24: 191-199, 1997.
3. Juvela S, Porras M, Poussa K: Natural History of Unruptured Intracranial Aneurysms: Probability and Risk Factors for Aneurysm Rupture. *Neurosurgical Focus* 8: 2000.

Glossary

aneurysm: a bulge or weakening of an arterial wall.

coiling: a procedure to insert platinum coils into an aneurysm; performed during an angiogram.

craniotomy: surgical opening in the skull.

Ehlers-Danlos IV: a genetic disorder of the connective tissue in the intestines, arteries, uterus, and other hollow organs may be unusually weak, leading to organ or blood vessel rupture.

embolization: inserting material, coil or glue, into an aneurysm so blood can no longer flow through it.

inherited: to receive from a parent or ancestor by genetic transmission.

Marfan's syndrome: a genetic disorder in which patients develop skeletal defects in long bones, chest abnormalities, curvature of the spine, and circulatory defects.

neurofibromatosis (NF1): a genetic disorder, also called von Recklinghausen disease, in which patients develop café-au-lait spots, freckling, and multiple soft tumors under the skin and throughout the nervous system.

polycystic kidney disease: a genetic disorder in which patients develop multiple cysts on the kidneys; associated with aneurysms of blood vessels in the brain.

subarachnoid hemorrhage: bleeding in the space surrounding the brain; may cause a stroke.

vasospasm: abnormal narrowing or constriction of arteries due to irritation by blood in the subarachnoid space.

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