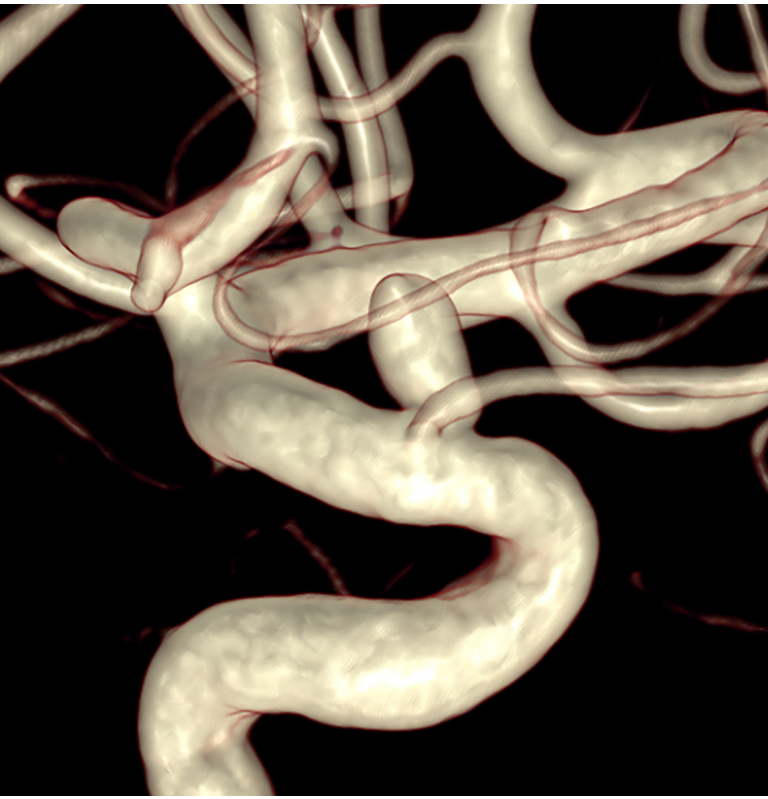
Brain Aneurysms

What You Should Know About Endovascular Therapy



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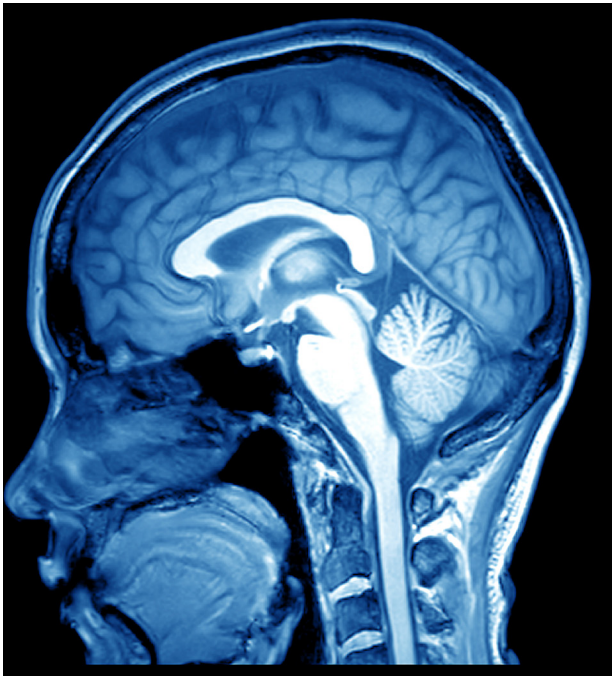

What is a Brain Aneurysm?

A brain aneurysm, also called a cerebral or intracranial aneurysm, is a weakness in the wall of an artery in the brain which leads to a bulging or ballooning out of part of the vessel. Aneurysms form silently from wear and tear on the arteries, and sometimes can form from injury, infection, or may be inherited. Aneurysms occur in all age groups, but the incidence increases steadily for individuals age 25 and older. The average age of rupture is in the mid 50s, and is more common in women. The main reason we worry about brain aneurysms is that rupture is life-threatening.

It is estimated that up to one in 15 people in the United States will develop a brain aneurysm during their lifetime.

Unruptured Aneurysms

Unruptured brain aneurysms are often asymptomatic, particularly when they are small. Large unruptured aneurysms may cause symptoms based on the pressure they put on surrounding structures, including brain tissue or nerves. Symptoms may include pain above and

behind the eye, numbness, weakness or paralysis on one side of the face, dilated pupil or vision changes.[1]

Unruptured aneurysms often require a different assessment and timeline for treatment than ruptured aneurysms. Some of the things that a doctor will consider in deciding whether or not to treat an unruptured aneurysm include:

- Risk of Hemorrhage – Is it probable or not that the aneurysm will rupture?
- Size, Shape, and Location
- Family History – Is there a family history? Have any of those aneurysms ruptured?
- Age and Health of Patient
- Presence of multiple aneurysms

Ruptured Aneurysms

When cerebral aneurysms rupture, they usually cause bleeding into the brain or the space closely surrounding the brain known as the "subarachnoid space". Blood can irritate, damage, or destroy nearby brain cells (Figure 1). Each year approximately 2% to 3% of people with a brain aneurysm suffer from bleeding. Ruptured brain aneurysms are fatal in about 50 percent of cases.

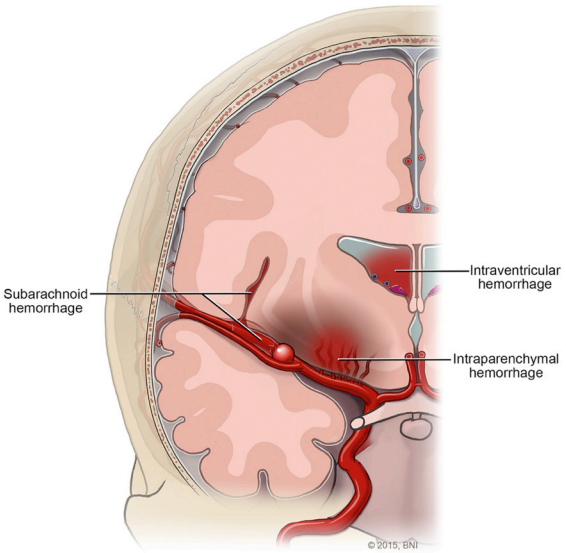

Figure 1. Subarachnoid hemorrhage from a ruptured cerebral aneurysm.

People who suffer a ruptured brain aneurysm may experience some or all of the following warning signs:

- Sudden onset of a headache often described as the worst headache of your life
- Nausea and vomiting
- Stiff neck
- Blurred or double vision
- Sensitivity to light
- Dilated pupils
- Loss of sensation

How are Brain Aneurysms Diagnosed?

Aneurysms can be diagnosed in several different ways. Diagnosis of a ruptured cerebral aneurysm is typically made by finding signs of subarachnoid hemorrhage on a CT scan (Computerized Tomography), which is a computerized test that rapidly X-rays the body in cross-sectional slices.

To determine the exact location, size and shape of an aneurysm, three options are available. Computed Tomographic Angiography (CTA) and Magnetic Resonance Angiography (MRA) are non-invasive options. Cerebral catheter angiography is the third and a minimally invasive option, considered the gold-standard.

CTA combines a regular CT scan with a contrast dye injected into a vein. Once the dye is injected into the vein, it travels to the brain arteries, and images are created using a CT scan. These images show exactly how blood flows into the brain arteries. MRA is another technique to image blood vessels which uses magnetic pulses rather than x-rays. MRA may not be safely performed in certain patients with specific metal or electrical implants in the body.

Cerebral angiography provides the highest spatial resolution of the three options and also provides an opportunity for endovascular treatment. It is a procedure in which contrast dye is injected into the arterial system through a catheter that is typically inserted through an artery in the groin or wrist.

How are Aneurysms Treated?

Today there are more treatment options than ever for people who have been diagnosed with a brain aneurysm.

- **Surgical clipping**
- **Endovascular therapy**

It is important to note, however, that not all aneurysms are treated at the time of diagnosis or are amenable to both forms of treatment. Patients need to consult a neurovascular specialist to determine if they are candidates for either treatment.

Surgical Clipping

An operation to "clip" the aneurysm is performed by doing a craniotomy (opening the skull surgically), and isolating the aneurysm from the bloodstream by placing one or more clips across the neck of the aneurysm. This eliminates further blood flow into the aneurysm, significantly reducing the risk of rupture. After clipping the aneurysm, the skull bone is secured in its original place, and the wound is closed. Surgical clipping of an aneurysm is always performed by a trained and licensed neurosurgeon.

Endovascular Treatment

A less invasive technique, called endovascular treatment, does not require a craniotomy. This technique uses existing spaces within the artery to deliver implants that can seal off the weakened aneurysm wall from any further contact with pulsatile arterial blood flow. Access into the blood vessels is via a small incision at the groin crease or wrist. Under X-ray guidance, a microcatheter is used to reach and deliver implants either within or adjacent to the aneurysm to induce stagnation of blood flow in the aneurysm, leading to thrombosis (clotting) of the aneurysm, thereby preventing future rupture.

Endovascular treatment traditionally involved the implantation of platinum coils within the aneurysm

(Figure 2). If the aneurysm neck is wide, an additional device is sometimes used to maintain coils in the aneurysm. For example, stents are a flexible cylindrical mesh tube that can provides a scaffold to stabilize any implanted coils.

Flow diverters are dense-mesh stents that can achieve aneurysm occlusion without placing coils into the aneurysm (Figure 3, 4). These braided devices function by redirecting flow to stay within the parent vessel, thereby inducing thrombosis in the aneurysm.

Most recently, flow disruptors, devices combining flow redirection braiding and a shape that fits inside the aneurysm, provide additional valuable options available for patients with complex anatomy surrounding their aneurysm (Figure 5).

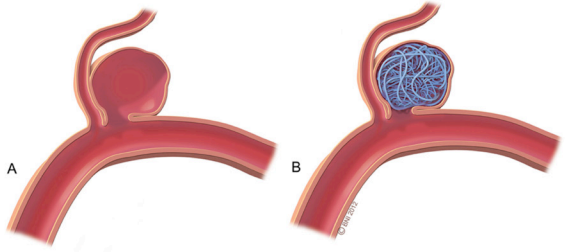

Figure 2. Aneurysm treatment before and after coil embolization

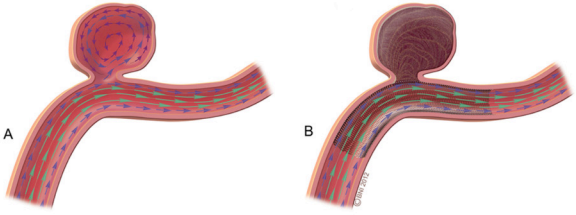

Figure 3. Aneurysm treatment before and after flow diversion

Figure 4. Flow diversion for wide neck large aneurysms

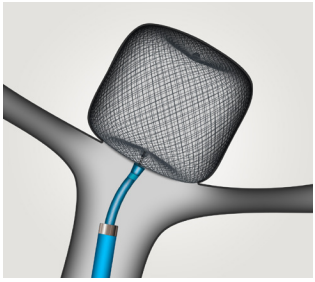

Figure 5. Aneurysm treatment with a flow disruptor

Endovascular treatment is performed by a trained and licensed neurointerventionalist. A neurointerventionalist has specialized training in neuroscience, neuroimaging, and neuroendovascular surgery for the brain and spine.

There are many major hospital centers in the U.S. that provide endovascular coiling. To find a doctor near you, visit **www.brainaneurysm.com**.

**Results from case studies are not necessarily indicative of results in other cases. Results in other cases may vary.*

Safety and Complications

While the best method of securing the aneurysm should be determined 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.

Although the frequency of certain complications may vary, both surgical and endovascular treatment have

risks. Aneurysm rupture is the most serious complication of either treatment. Rupture can cause intracerebral hemorrhage (bleeding into the brain), subsequent coma or death. Ischemic stroke, which is a stroke caused by interruption of blood flow to the brain, is also a potential risk of either treatment.

Which Procedure Should I Have?

The treatment of choice for an intracranial aneurysm, like all medical decisions, should be agreed upon by both the physician and the patient. In the case of both ruptured and unruptured intracranial aneurysms, the treating physician should discuss the risks and benefits of each available treatment option. The physician will usually make recommendations for one treatment over another, depending on the facts of each individual case.

Treatment of Ruptured Aneurysms

Results from the International Subarachnoid Aneurysm Trial (ISAT), a randomized control trial which compared surgical clipping to endovascular coiling in the treatment of ruptured aneurysms, were published in the Lancet in 2002. The study found that in patients equally suited for both treatment options, endovascular coil treatment produced substantially better patient outcomes than surgery in terms of survival free of disability at one year.[2] The relative risk of death or significant disability at one year for patients treated with coils was 23.5% lower than in surgically-treated patients, an absolute risk reduction of 7.4%.[3] The study results were so compelling that the trial was halted early because the trial steering committee determined it was no longer ethical to randomize patients to clipping.

Long-term follow-up from the ISAT trial was published in 2009. The risk of death at five years was significantly lower in the coiled group than in the clipped group. There was an increased risk of recurrent bleeding from the coiled group compared to the clipped group, but the risks were small.[4]

Treatment of Unruptured Aneurysms

Although no multi-center randomized clinical trial comparing endovascular coiling and surgical treatment of unruptured aneurysms has yet been conducted, retrospective analysis found that endovascular coiling is associated with less risk of negative outcomes, shorter hospital stays and shorter recovery times compared with surgery.

Open surgery vs. endovascular treatment?

Factors other than aneurysm anatomy are also important, including patient age, health status, other medical conditions, and aneurysm location. While largely unstudied, the less invasive nature of endovascular treatment is likely to be favored with older patients, fragile health status, serious comorbid medical conditions, and certain aneurysm locations. Despite the continued evolution of endovascular techniques (devices), some ruptured aneurysms may not be favorable for endovascular treatment. For aneurysms with favorable anatomy for an endovascular approach, however, the arguments for primary surgical clipping continue to decrease.[5]

Although the best treatment option for an individual patient can sometimes be complicated, the choice between surgical clipping or endovascular treatment is best approached with a thorough understanding of an individual patient's case.

Glossary of Terms

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

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

Balloon: An interventional device designed for use in the blood vessels of the peripheral and neurovasculature where temporary support or pause in blood flow is desired.

Brain Aneurysm: A weak bulging spot on the wall of one of the arteries in the brain – also called an intracranial or cerebral aneurysm.

Catheter: A hollow flexible tube for insertion into a body cavity, duct, or vessel to allow the passage of fluids or distend a passageway. Used in the endovascular treatment of cerebral aneurysms.

Cerebral Aneurysm: A weak bulging spot on the wall of one of the arteries in the brain – also called a brain or cerebral aneurysm.

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

Coils: Small platinum threads used to occlude (fill) cerebral aneurysms. The coils are attached to a delivery wire and are fed through a microcatheter into the aneurysm. Once properly positioned within the aneurysm, the coil is detached from the delivery wire.

Craniotomy: Surgical procedure where a section of the skull cap is temporarily removed. Necessary in the surgical treatment of cerebral aneurysms.

Endovascular: Within the vascular system.

Endovascular Embolization: A technique that seals off the cerebral aneurysm and stops further blood from entering into the aneurysm. This method uses natural access through the bloodstream via arteries to diagnose and treat cerebral aneurysms.

Hemorrhagic Stroke: A stroke caused by a ruptured blood vessel and characterized by bleeding within or surrounding the brain. A subarachnoid hemorrhage from a ruptured cerebral aneurysm can lead to hemorrhagic stroke.

Intracranial Stenting: Vascular reconstruction using stents for the treatment of patients with wide-necked aneurysms.

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.

Stent: A cylindrical mesh tube device made of metal that is placed into the intracranial circulation for the treatment of wide-necked aneurysms.

Subarachnoid Hemorrhage (SAH): Bleeding into the compartment surrounding the brain, caused by the rupture of a cerebral aneurysm; can lead to hemorrhagic stroke, brain damage and death.

References

1 NINDS: https://www.ninds.nih.gov/

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3 Mitchell, P, Kerr R, Mendelow D, Molyneux A. Could late rebleeding overturn the superiority of cranial aneurysm coil embolization over clip ligation seen in the International Subarachnoid Aneurysm Trial? J Neurosurg 108: 437-442, 2007

4 Molyneux A, Kerr R, Stratton I, Sandercock P, Clarke M, Shrimpton J, Homan R. Risk of recurrent subarachnoid hemorrhage, death, or dependence and standardized mortality ratios after clipping or coiling of an intracranial aneurysm in the International Subarachnoid Aneurysm Trial (ISAT): long term follow up. The Lancet Neurology 2009, May, 8(5): 427-433

5 American Academy of Neurology Science Editorials and Reviews

More information is available at
www.brainaneurysm.com

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