



## Embolization of Brain Aneurysms and Arteriovenous Malformations/Fistulas

Embolization of brain aneurysms and arteriovenous malformations (AVM) uses imaging guidance to place small, soft metal coils into an aneurysm to block the flow of blood and prevent the aneurysm from rupturing. It also is used to fill AVMs – abnormal connections between arteries and veins – with liquid embolic agents (similar to fast-sealing glue). AVMs may prevent oxygenated blood from completely circulating throughout the brain and can cause a variety of problems, including headache, weakness, and other neurological symptoms. Embolization treats cerebral aneurysms and AVMs previously thought inoperable and is much less invasive than open surgery.

Your doctor will instruct you on how to prepare, including any changes to your medication schedule. Tell your doctor if there's a possibility you are pregnant and discuss any recent illnesses, medical conditions, allergies and medications you're taking, including herbal supplements and aspirin. You may be advised to stop taking aspirin, nonsteroidal anti-inflammatory drugs (NSAIDs) or blood thinners several days prior to your procedure. You also may be told not to eat or drink anything after midnight before your procedure. Plan to stay at the hospital overnight. Leave jewelry at home and wear loose, comfortable clothing. You will be asked to wear a gown.

### What is Embolization of Brain Aneurysms and Fistulas?

Embolization of brain aneurysms and arteriovenous malformations (AVM)/fistulas is a minimally invasive treatment for aneurysms and other blood vessel malformations that occur in the brain. These problems are typically identified in adults; however, aneurysms and AVMs can also occur in children.

An aneurysm is a bulge or sac that develops in an artery because the wall of the vessel is weak. A bulging aneurysm in the brain may compress surrounding nerves and brain tissue resulting in nerve paralysis, headache, neck and upper back pain as well as nausea and vomiting. If an aneurysm in the brain ruptures, causing an opening in the artery wall, the resulting bleeding in the head may cause a stroke or death.

An AVM is an abnormal connection or passageway between the arteries and veins. AVMs may prevent oxygenated blood from completely circulating throughout the brain, causing symptoms including, but not limited to:

- unusual sound in one ear (pulsating or humming)
- neurological symptoms
- increased pressure in the eye (glaucoma)
- double vision

- pain/headache

In embolization procedures, physicians use image guidance to place small, soft metal coils within the aneurysm, where it helps block the flow of blood and prevent rupture of the aneurysm. A stent may be used to help keep the coils inside a wide neck aneurysm. A special stent called a flow diverter may be used with or without coils to direct the flow of blood away from the aneurysm and cause it to clot and heal. Stents and flow diverters require patients to take blood thinners (such as aspirin, Plavix, etc.). Similarly, physicians use image guidance to fill AVMs with liquid embolic agents (similar to fast-sealing glue), thereby treating the presenting symptoms, and preventing new ones.

## What are some common uses of the procedure?

Embolization is frequently used to treat aneurysms and AVMs in the brain. It may be performed on both ruptured and unruptured aneurysms.

## How should I prepare for the procedure?

Prior to your procedure, your blood may be tested to determine how well your kidneys are functioning and whether your blood clots normally.

Your blood may also be tested to verify that you respond to blood thinners.

You should report to your doctor all medications that you are taking, including herbal supplements, and if you have any allergies, especially to local anesthetic medications, general anesthesia or to contrast materials containing iodine (sometimes referred to as "dye" or "x-ray dye"). Your physician may advise you to stop taking aspirin, nonsteroidal anti-inflammatory drugs (NSAIDs) or blood thinners for a specified period of time before your procedure.

Also inform your doctor about recent illnesses or other medical conditions.

Women should always inform their physician and x-ray technologist if there is any possibility that they are pregnant. Many imaging tests are not performed during pregnancy so as not to expose the fetus to radiation. If an x-ray is necessary, precautions will be taken to minimize radiation exposure to the baby. See the Safety page for more information about pregnancy and x-rays.

If your aneurysm has ruptured, you will be hospitalized for several days following your embolization procedure in order to prevent additional problems. If your aneurysm has not ruptured, you should plan to have a relative or friend drive you home after your procedure or the following day, depending on what your doctor recommends.

You should plan to stay overnight at the hospital for one or more days.

You will be given a gown to wear during the procedure.

## What does the equipment look like?

In this procedure, a catheter and detachable coils are used.

A catheter is a long, thin plastic tube that is considerably smaller than a "pencil lead", or approximately 1/8 inch in diameter.

There are three types of coils:

- bare platinum coils
- coated platinum coils
- biologically active coils.

Metal stents are used to keep the coils inside the aneurysm.

Coils are made of soft platinum wire smaller than a strand of hair and are available in different diameters and lengths. All detachable coils are scientifically proven to be safe and effective and approved by the U.S. Food and Drug Administration (FDA).

Other equipment that may be used during the procedure includes an intravenous line (IV), ultrasound machine and devices that monitor your heart beat and blood pressure.

## How does the procedure work?

In an embolization procedure, a catheter, (a long, thin, hollow plastic tube), is inserted through the skin into an artery and, using image-guidance, maneuvered through the body to the site of the aneurysm or AVM. For aneurysms:

- one or more coils are inserted through the catheter and placed within the aneurysm, where it is anchored
- A stent or flow diverter may be placed in the artery across the aneurysm

The body responds by healing around the coil(s), which helps block the flow of blood into the aneurysm, preventing it from rupturing or leaking. For AVMs, a similar catheter is placed at the point of abnormal connection between arteries and veins. A liquid adhesive agent is then injected to plug this connection. Other connections requiring similar treatment are then treated with additional catheters placed in their locations.

## How is the procedure performed?

Image-guided, minimally invasive procedures such as brain aneurysm embolization are most often performed by a specially trained interventional neuroradiologist in an interventional radiology suite.

Prior to your procedure, computed tomography (CT) or magnetic resonance imaging (MRI) may be performed.

You will be positioned on the examining table.

You may be connected to monitors that track your heart rate, blood pressure and pulse during the procedure.

A nurse or technologist will insert an intravenous (IV) line into a vein in your hand or arm so that sedative medication can be given intravenously. Moderate sedation may be used. As an alternative, you may receive general anesthesia.

The area of your body where the catheter is to be inserted will be sterilized and covered with a surgical drape.

Your physician will numb the area with a local anesthetic.

A very small skin incision is made at the site.

Using image-guidance, a catheter, a long, thin, hollow plastic tube, is inserted through the skin and advanced to the site of the aneurysm or AVM. The aneurysm or AVM is treated through the techniques described above.

At the end of the procedure, the catheter will be removed and pressure will be applied to stop any bleeding. The opening in the skin is then covered with a dressing. No sutures are needed.

Your intravenous line will be removed.

If your aneurysm or AVM ruptured and resulted in a stroke, you will need to remain in the hospital until you are recovered

If you were treated for an aneurysm or AVM that had not yet caused a problem, you may stay overnight at the hospital and return home the day after your procedure.

This procedure is usually completed in one to two hours; however, it may last up to several hours.

## **What will I experience during the procedure?**

Devices to monitor your heart rate and blood pressure will be attached to your body.

If you receive a general anesthetic, you will be unconscious for the entire procedure, and you will be monitored by an anesthesiologist.

You will feel a slight pin prick when the needle is inserted into your vein for the intravenous line (IV) and when the local anesthetic is injected. Most of the sensation is at the skin incision site, which is numbed using local anesthetic. You may feel pressure when the catheter is inserted into the vein or artery.

You may feel slight pressure when the catheter is inserted, but no serious discomfort.

If you were treated for an aneurysm or AVM that had not yet caused an acute problem, you should be able to resume your daily activities after 24 hours.

If you were treated for a ruptured aneurysm or AVM, you may experience mild nausea and a low-grade

fever following your procedure. Headaches may last from seven days to six months. You may be prescribed aspirin or blood thinners.

Recovery time varies by patient and depends on the amount of the brain injury caused by bleeding from the ruptured aneurysm. Most people are able to care for themselves within 10 days to six months following this embolization procedure. Many patients return to work after one month and begin driving three months later.

## Who interprets the results and how do I get them?

The interventional neuroradiologist will evaluate your procedure and results and coordinate appropriate follow-up care with your primary care physician.

## What are the benefits vs. risks?

### Benefits

- Using detachable coils, stents and flow diverters to close off an aneurysm is effective in prolonging life and relieving symptoms.
- Embolization is a treatment for cerebral aneurysms and AVMs that previously were considered inoperable. This procedure is less invasive and requires significantly less recovery time than open surgery.
- No surgical incision is needed—only a small nick in the skin that does not have to be stitched.

### Risks

- Any procedure where the skin is penetrated carries a risk of infection. The chance of infection requiring antibiotic treatment appears to be less than one in 1,000.
- Any procedure that involves placement of a catheter inside a blood vessel carries certain risks. These risks include damage to the blood vessel, bruising or bleeding at the puncture site, and infection. However precaution is taken to mitigate these risks.
- There is always a chance that an embolic agent can lodge in the wrong place and deprive normal tissue of its oxygen supply.
- There is a slight risk of death or illness. Embolization of unruptured aneurysms and AVMs carries less risk than treatment performed on an emergency basis. Approximately seven percent of cases require additional treatment or surgery.

## What are the limitations of Embolization of Brain Aneurysms and AVMs?

**Durable effect:** Recurrence depends on the coils' success or failure in controlling the "neck" of the aneurysm. If the coil completely prevents blood flow into the aneurysm, then the patient need not be

concerned about recurrence. The durability of coil embolization varies depending on the size and shape of the aneurysm. Coil embolization of small aneurysms with small necks has better results than embolization of large or giant aneurysms with wide necks. Long-term follow-up has shown permanent success in more than 80 percent of aneurysms treated with coil embolization. Additional medical technologies, such as balloon assistance, microstenting and flow diversion are improving the success of treating brain aneurysms with coil embolization. Unfortunately, large aneurysms with wide necks remain a challenge. AVMs can be well treated through these embolization techniques, although continued checkups are required.

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