CONDITION

Vascular malformations of the brain

Vascular malformations of the brain are abnormal connections or formations of blood vessels in or around the brain.

WHAT IT IS
Abnormal blood vessels in or around the brain

BODY SYSTEM
Brain, nervous system, heart and circulation

MAIN SYMPTOMS
Headache, seizures, weakness, vision or speech changes

WHAT CAUSES IT
Usually developmental; sometimes inherited or acquired

HOW IT IS DIAGNOSED
MRI, vessel imaging, sometimes catheter angiography

MAIN TREATMENT
Monitoring, surgery, embolization, or focused radiation

CAN IT BE CURED?
Sometimes - complete removal or closure is possible

IS IT AN EMERGENCY?
Sometimes - sudden severe headache or stroke signs

LONG-TERM OUTLOOK
Many remain stable; bleeding risk differs by type

Overview

Vascular malformations of the brain are abnormal groups or connections of blood vessels. They may be inside the brain, on its surface, or within the tough covering around it, called the dura.

Several conditions fall under this name:

These malformations do not all behave in the same way. Some are found by chance and never cause problems. Others can cause seizures, pressure-related symptoms, or bleeding in or around the brain. The type, location, previous bleeding, and pattern of blood flow all help determine the risk.

A vascular malformation is not a brain tumor. It does not spread like cancer. However, some

types need monitoring because their blood vessels can leak or rupture.

- Arteriovenous malformations (AVMs) connect arteries directly to veins without the usual small vessels between them.
- Cavernous malformations , or cavernomas, are clusters of enlarged, thin-walled blood vessels with slow blood flow.
- Developmental venous anomalies (DVAs) are unusual arrangements of veins that usually drain normal brain tissue.
- Capillary telangiectasias are small areas of widened capillaries, the body's tiniest blood vessels.
- Dural arteriovenous fistulas (dAVFs) are abnormal links between arteries and veins in the brain's outer covering.

Symptoms

Many vascular malformations cause no symptoms. They may be discovered during a scan performed for an unrelated reason.

When symptoms occur, they can develop gradually or begin suddenly. Possible symptoms include:

Symptoms depend strongly on where the malformation is located. For example, one near areas controlling movement may cause weakness, while one close to visual pathways may affect sight.

A sudden, extremely painful headache, especially with weakness, confusion, vomiting, seizure, or loss of consciousness, can be a sign of bleeding and needs emergency care.

- Headaches, which may be persistent, recurring, or sudden
- Seizures
- Weakness, numbness, poor balance, or coordination problems
- Changes in speech, memory, vision, hearing, or understanding
- A rhythmic "whooshing" sound in one ear, called pulsatile tinnitus
- Eye redness, swelling, pain, double vision, or a bulging eye with some dAVFs
- Nausea, vomiting, confusion, or reduced alertness if bleeding occurs

Causes and risk factors

Many brain vascular malformations develop before birth as blood vessels form. This does not necessarily mean they are inherited. Most brain AVMs occur without a clear cause or family history.

Cavernous malformations may occur as a single, non-inherited lesion. Some people have a familial form caused by a change in a gene. Familial cavernous malformations are more likely when a person has several lesions or close relatives with the condition.

Brain AVMs may also occur as part of hereditary hemorrhagic telangiectasia, an inherited condition that affects blood vessels in several parts of the body.

Dural arteriovenous fistulas are generally considered acquired rather than present from birth. They may form after a blood clot in a large draining vein, head injury, infection, or surgery, although no cause is found in many cases.

There is usually nothing a person did to cause a vascular malformation.

Diagnosis

A clinician may suspect a vascular malformation because of symptoms, a neurological examination, or an unexpected finding on a scan.

Magnetic resonance imaging (MRI) provides detailed pictures of the brain. Special MRI sequences are particularly good at showing cavernous malformations and small areas of previous bleeding.

Computed tomography (CT) is often used urgently when bleeding is suspected because it can quickly detect fresh blood. CT angiography or magnetic resonance angiography can show arteries, veins, and blood flow.

A catheter angiogram , also called cerebral angiography, gives the most detailed view of fast-flowing AVMs and fistulas. A thin tube is guided through an artery, usually from the wrist or groin, and contrast dye is injected while X-ray images are taken. This test is invasive, so it is used when the added detail may affect diagnosis or treatment.

Cavernous malformations usually do not appear on a catheter angiogram because blood moves through them slowly. Their diagnosis is mainly based on MRI.

Genetic counseling or testing may be offered when there are multiple cavernous malformations, a suggestive family history, or features of an inherited blood-vessel condition.

Treatment and management

Treatment is based on the exact type of malformation rather than the general label. The healthcare team considers previous bleeding, symptoms, location, size, drainage pattern, age, general health, and the risks of each procedure.

Observation may be appropriate for a malformation that has not caused symptoms or has a low-risk pattern. Monitoring can include clinical reviews and repeat imaging. Not every vascular malformation needs regular scans, so follow-up plans differ by type.

Medicines may control symptoms such as seizures or headaches, but they do not remove the malformation. Do not stop anti-seizure, blood-thinning, or other prescribed medicines without medical advice.

Procedural treatments include:

Embolization may be the main treatment for some dAVFs. For an AVM, it is often used before surgery or radiosurgery, although it may sometimes be used alone. Radiosurgery does not close an AVM immediately; closure may take several years, and bleeding remains possible during that period.

Selected cavernous malformations may be removed if they have caused repeated bleeding, seizures that remain difficult to control, or worsening neurological problems. Surgery is not suitable for every location.

DVAs usually need no treatment. Removing or blocking one can interfere with drainage from normal brain tissue. Capillary telangiectasias also commonly need observation only.

For an unruptured AVM, the balance between treatment and observation can be complex because treatment itself carries risks. Review by a team experienced in cerebrovascular conditions can help clarify the options.

- Microsurgery , in which a neurosurgeon removes or disconnects the malformation through an opening in the skull
- Endovascular embolization , in which a catheter is used to place material that blocks abnormal blood flow
- Stereotactic radiosurgery , which directs focused radiation at a small AVM so that its vessels gradually close

Complications

The main serious complication is bleeding, called an intracranial hemorrhage. Blood may damage nearby brain tissue and cause a hemorrhagic stroke.

Other possible complications include seizures, lasting weakness or sensory changes, speech or vision problems, and difficulty with memory or concentration. Abnormal blood flow can sometimes increase pressure in nearby veins or interfere with the circulation of fluid around the brain.

Procedures also have risks, including bleeding, stroke, infection, reactions to contrast dye, or injury to nearby brain tissue. The type and likelihood of complications differ between treatments and malformations.

Prevention

Most brain vascular malformations cannot be prevented. Those that develop before birth or result from an inherited gene change are not caused by diet, exercise, stress, or another controllable behavior.

General measures such as not smoking and managing high blood pressure support overall blood-vessel health, but they do not make a vascular malformation disappear. There is no proven diet, supplement, or exercise program that closes one.

If an inherited condition is confirmed, genetic counseling can explain the chance of relatives being affected and whether family testing is appropriate. It cannot prevent the gene change, but it may support earlier recognition.

Living with it and what to expect

The long-term course differs by malformation type. Many DVAs, capillary telangiectasias, and incidentally discovered cavernous malformations remain stable. Some AVMs and dAVFs carry a meaningful bleeding risk even when symptoms are limited.

Follow-up may involve a neurologist, neurosurgeon, or interventional neuroradiologist, who treats blood vessels using image-guided procedures. Keep scheduled appointments even if you feel well, particularly when monitoring an untreated lesion or checking whether treatment has fully closed it.

After a bleed or procedure, recovery may continue for months. Rehabilitation can help with movement, speech, vision, memory, fatigue, or returning to work. Some effects improve, while others can remain.

Physical activity is not automatically unsafe. Advice may be adjusted if an activity causes heavy straining, involves a major risk of head injury, or would be dangerous during a seizure. Driving rules depend on symptoms, especially seizures, and local law.

Pregnancy and birth planning should be discussed in advance if possible. Having a vascular malformation does not by itself mean pregnancy is unsafe or that a cesarean birth is required. Planning depends on the lesion, previous bleeding, symptoms, and treatment history.

When to get medical help

Call emergency services for:

These symptoms can have several causes, but they may indicate bleeding, stroke, or dangerous pressure around the brain.

Arrange prompt, non-emergency medical review for a new rhythmic whooshing sound in one ear, recurring unexplained seizures, gradually worsening neurological symptoms, or a major change in an established headache pattern.

For a known, stable malformation, routine follow-up is appropriate when there are no new symptoms. Contact the team sooner if symptoms change rather than waiting for the next planned appointment.

- A sudden, severe headache that reaches maximum intensity quickly
- New weakness, numbness, facial drooping, trouble speaking, or loss of vision
- A first seizure, a seizure lasting more than five minutes, or repeated seizures without recovery
- Sudden severe confusion, collapse, or loss of consciousness
- Severe headache with repeated vomiting, unusual drowsiness, or difficulty walking
- Sudden eye swelling, pain, or vision loss, particularly with pulsatile tinnitus

Common questions

Is a brain vascular malformation a tumor?

No. It is an abnormal formation or connection of blood vessels, not a cancerous growth. It does not spread to other parts of the body.

Can a vascular malformation burst?

Some can bleed, but the likelihood is not the same for every type. Previous bleeding, location, blood-flow pattern, and how veins drain the area can affect risk. A specialist can explain what the imaging shows in an individual case.

Does every brain AVM need surgery?

No. Options include observation, surgery, embolization, radiosurgery, or a combination. For an unruptured AVM, treatment is recommended only after balancing its future risks against the immediate and delayed risks of a procedure.

Can I exercise with a brain vascular malformation?

Many people can remain active. Restrictions are not the same for everyone. Advice may be needed for heavy lifting, contact sports, high-risk activities, or exercise after a recent bleed or procedure.

Are vascular malformations hereditary?

Most brain AVMs are not inherited. Familial cavernous malformations and hereditary hemorrhagic telangiectasia can run in families. Multiple lesions or affected close relatives may be reasons to consider genetic counseling.

Can a treated malformation come back?

Complete surgical removal or closure can cure some malformations, but follow-up imaging may be needed to confirm this. A lesion can sometimes remain partly open, reopen, or rarely recur, particularly in children. The follow-up plan depends on the treatment and type.

Sources

- National Institute of Neurological Disorders and Stroke. Arteriovenous Malformations and Other Vascular Lesions of the Central Nervous System .
- Derdeyn CP, Zipfel GJ, Albuquerque FC, et al. Management of Brain Arteriovenous Malformations: A Scientific Statement for Healthcare Professionals From the American Heart Association/American Stroke Association . Stroke . 2017;48:e200-e224.
- Akers A, Al-Shahi Salman R, A Awad I, et al. Synopsis of Guidelines for the Clinical Management of Cerebral Cavernous Malformations . Neurosurgery . 2017;80:665-680.
- Baharvahdat H, Ooi YC, Kim WJ, Mowla A, Coon AL, Colby GP. Updates in the Management of Cranial Dural Arteriovenous Fistula . Stroke and Vascular Neurology . 2020;5:50-58.
- National Health Service. Arteriovenous malformation .