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Neurosurgery

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Arteriovenous Malformation

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SPECIAL POINTS OF INTEREST:

- **Most people with AVMs are born with them.**
- **AVMs usually present with either a bleed (stroke) or seizure.**
- **Treatment options include surgery, radiosurgery and embolization.**
- **Management needs expert advice from a cerebrovascular neurosurgeon.**

INSIDE PAGES:

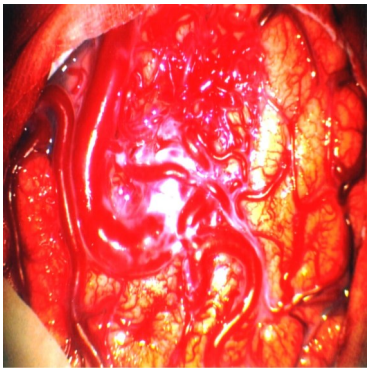
What is an AVM?

An arteriovenous malformation (AVM) is an abnormal cluster of blood vessels that has a very high blood flow, with the blood flowing directly from the high pressure arteries into the lower pressure vein, bypassing the very small capillaries. AVMs can occur in almost any organ in the body, but most frequently cause problems in the brain. This information sheet will be confined to AVMs of the brain.

Patients are usually born with arteriovenous malformations, although they often do not cause problems until significantly later in life.

AVM's usually are diagnosed after they cause one or more of three different types of problems: bleeding, seizures and neurological deficits.

Bleeding is the most serious problem caused by an AVM, and is discussed in detail in the section below.



Distended AVM vessels on the surface of the brain

Some AVM's present with an epilepsy seizure. Seizures are slightly more common in young people than older people. A teenager with an AVM has about a 44% risk of developing seizures over the next 20 years, whereas a person aged 30 to 60 years with an AVM, who has never had a seizure, has only about a 6% chance of developing a seizure in the next 20 years. A patient with an AVM that has bled has about a 22% risk of developing epilepsy over the next 20 years.

Rarely, AVMs can present with slowly progressive neurological deficits such as weakness or sensory disturbance, or sometimes visual disturbance (depending where the AVM is situated in the brain). This is due to the blood flowing through the AVM bypassing the surrounding brain (this often being called "steal" of the blood flow).

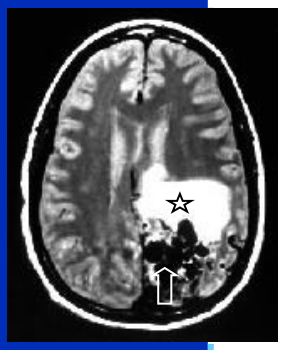
AVM bleeding

The vessels in an AVM can rupture and bleed at any time of life, from early infancy to old age. Statistically the risk of an AVM bleeding, regardless of its size or position, is about 3% per year. Therefore, if you have an AVM, regardless of your age, the chance of it bleeding over the next year is relatively small, only about 3% (therefore you have about a 97% chance that it will not bleed over any particular one year period).

However, the bleeding risk remains every year, and therefore statistically the chance of you having a bleed over the next two years is about 5.9%, and over the next five years is 14.1%.

In patients who have had a bleed from an AVM, it is thought that the risk of bleeding again is about double the usual annual risk for the first year after the bleed (ie 6% to 10% over the first year), but if it

AVM bleeding (continued from page 1)

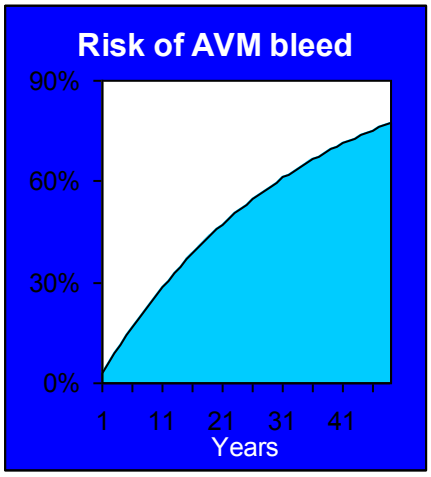


MRI scan showing ruptured AVM in occipital lobe (arrow) with clot in the brain (star).

does not re-bleed in the first year then it reverts to the usual 3% per year.

There is some evidence to suggest that smaller AVMs actually have a slightly higher risk of bleeding than larger AVMs, although this is open to debate.

As the AVM lies within the brain tissue, if it bleeds the blood enters the brain substance (damaging the brain), although sometimes it can bleed around the outside of the brain (subarachnoid haemorrhage; SAH) or into the ventricular system (intraventricular haemorrhage; IVH). The position of the AVM in the brain determines how likely the patient is to develop a major problem if they have a bleed.



Overall the risk of death each time an AVM bleeds is about 10%. There is about a 30% to 50% chance of having a significant neurological deficit (stroke) with each bleed.

Should an AVM be treated?

"Treatment must totally remove or obliterate the AVM, as partial treatment does not reduce the risk of bleeding."

All people with an AVM should seriously consider treatment options because of the long-term risk of the AVM bleeding and causing either death or stroke. However, each individual case needs to be specifically considered, particularly with respect to the size and site of the AVM, and the patient's age and general health (all of these things affect the risk associated with treatment),

Patients should therefore see an expert cerebrovascular neurosurgeon experienced in the management of AVMs to assess the risks of treatment against the risk of bleeding if left untreated, and also to determine the relative risks and benefit of each treatment.

The main reason for treating an AVM is to prevent the risk of the AVM bleeding. In general, treating the AVM does not have a major impact on the long-term risk of seizures, and if seizures are present these are usually best treated with anti-epilepsy medication.

The aim of treatment must be to totally remove or obliterate the AVM. Partial treatment (i.e, removal/ obliteration of part or most of the AVM, but leaving some intact AVM), does not reduce the risk of bleeding.

Imaging the AVM

Angiogram being performed (left) and angiogram of AVM (above)

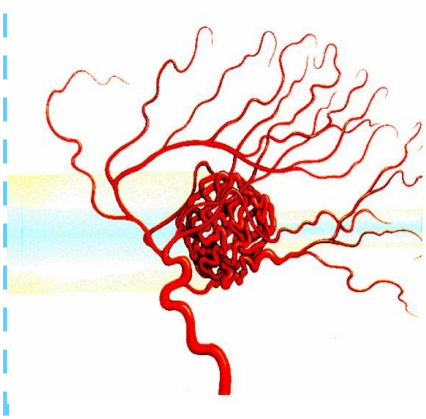
Although some AVMs can be seen on CT scan, MRI scan is usually required for good anatomical detail.

However, to accurately determine the vessels involved in the AVM, a cerebral angiogram (digital subtraction angiogram; DSA) is required.

For angiography, a fine tube (catheter) is inserted into the artery in the groin, and then floated in the bloodstream into the arteries supplying the brain. Dye (contrast) is then injected through the catheter into these arteries and a rapid sequence of xrays taken, showing the arrangement of arteries and veins and the blood flow through them

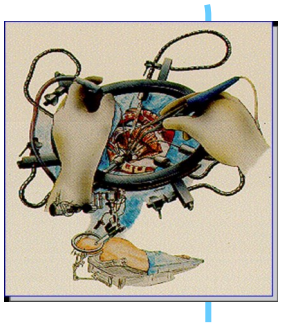
The risks of angiography, if performed by a skilled neuroradiologist, are small (usually <1%), but can include stroke, contrast allergy, and vascular injury.

Surgery for AVM



Surgical removal of an AVM involves a craniotomy (lifting a plate of skull bone, which is replaced at the end of the procedure) to give access to the AVM in the brain. Computerised localisation (stereotaxy) is usually used.

Under the operating microscope the main arteries supplying the AVM are individually located and sealed, usually by coagulating them, or occasionally with clips. The mass of AVM vessels (the nidus) is then meticulously dissected out of the brain tissue, this usually exposing a large number of finer vessels which also need to be individually sealed, and divided. Finally the large draining veins are sealed and divided, before removing the nidus.



This is an extremely technically demanding procedure, and only usually performed by cerebrovascular neurosurgeons experienced in AVM surgery.

The risks of the procedure are largely dependent on the size and the site of the AVM, as well as the amount of blood flow through the AVM, and the patient's general health. The experience of the cerebrovascular neurosurgeon is also a major factor determining the risk.

"Radiosurgery is a good option for small AVMs which are in a deep position difficult to access surgically"

Radiosurgery for AVM

Radiosurgery involves using stereotaxy to accurately deliver radiation to a localised part of the brain (the nidus of the AVM). The stereotactic guidance is used focus the radiation in a precise manner, delivering a very high dose of radiation to the AVM, while the surrounding brain to only receives a relatively small dose of radiation. The radiation slowly causes damage to the AVM blood vessels which then hopefully block off over time It usually takes 2-3 years for obliteration of a small AVM.

Radiosurgery is more appropriate for small AVMs(< 3cm) as the cure rate for larger AVMs is not good.

The risks of radiosurgery include delayed radiation injury to the surrounding area of the brain, as well as the ongoing risk of the AVM bleeding while waiting for the radiation treatment to obliterate the AVM over the next few years. Long-term effects of radiation (such as causing cancer) are thought to be very small.

In general, radiotherapy is a very good option for small AVMs in a deep position in the brain (which would make it difficult to access microsurgically).

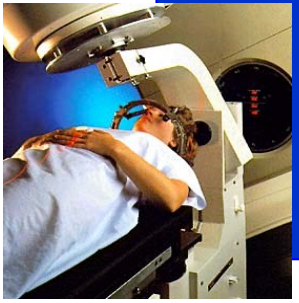
Before (left) **and after** (below) **embolisation angiograms.**

Embolisation of AVM

Embolisation involves another cerebral angiogram, but the catheters are passed up into the arteries in the brain and even into the AVM itself. Material is then injected into the AVM vessels, blocking them off. This material can either be small metal coils, other particles, or often types of glue.

This technique used alone can cure some (usually very small) AVMs. It is also used in some larger AVMs before surgery to reduce the blood flow and make surgery safer.

The risks of embolisation include stroke caused by the material blocking a normal brain artery. Also the AVM can rupture during the embolisation, or soon afterwards (because of alteration of the blood flow within it). These risks depend on the site, size and anatomy of the AVM, and in particular on the expertise of the interventional radiologist doing the procedure.



Radiosurgery: the patient is awake

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Associate Professor John Laidlaw is an experienced neurosurgeon in Australia and USA. His areas of particular interest and expertise include cerebrovascular surgery, skull-base surgery, brain tumour surgery, and surgery on the cervical spine and craniocervical junction.

Surgery, if appropriate, is usually performed using the most minimally invasive microsurgical techniques appropriate to the case. All surgical procedures are performed at The Royal Melbourne and Melbourne Private Hospitals.

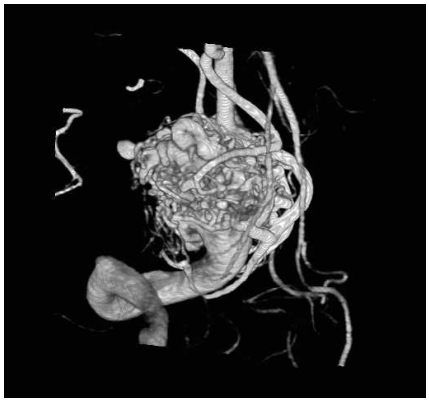
All consultations (insured or uninsured patients, Parkville or Geelong rooms, or Royal Melbourne Hospital clinics) should be arranged through the Parkville rooms.

What AVM treatment is best?

The best treatment for an AVM obviously depends on a number of factors, particularly the person's age and general health, whether the AVM has bled or not, how large the AVM is, which arteries feed it, which veins it drains into, and in particular what part of the brain the AVM is located in.

As a general rule, young patients with small and medium sized (and even some large) AVMs in surgically accessible and relatively safe (non-eloquent) areas of the brain would be advised to have surgical excision of the AVM. However, similar patients with small AVMs, in deep areas not easily accessible surgically, would often be advised to have radiosurgery. Some elderly patients, and patients with poor general health, and some patients with very large AVMs, or AVMs in an area that is considered very risky to treat (eloquent areas of the brain), may be advised that the safest option is to have no treatment.

Obviously there are many things to consider in the management a particular patient with an AVM, and patients are strongly advised to seek expert opinion from an experienced cerebrovascular neurosurgeon who is skilled and has particular expertise and management of AVMs. Cerebrovascular neurosurgeons work closely with expert interventional radiologists (who do angiography and embolisation), and also with radio-oncologists (who do radiosurgery), and the decision and treatment process would involve these other specialists as appropriate.



It is essential that people with AVMs talk at length with their treating cerebrovascular neurosurgeon, and ask questions so they are fully informed about the risks of their particular case, and the experience of the treating team. Only then can they determine which treatment has the best chance of curing their AVM, and whether the risk of that treatment is less than the risk of the AVM bleeding if untreated.