BroadcastMed | Arteriovenous malformations (AVMs), treatment considerations and options

Hello, my name is Ben Brown, and I'm a cerebrovascular and endovascular neurosurgeon at the Mayo Clinic in Jacksonville, Florida. Today I'd like to talk to you about the treatment options for cerebral arterial venous malformations, or AVMs. I'll give a brief overview of cerebral AVMs, the treatment considerations, and the options available.

What are cerebral arterial venous malformations? Briefly, a AVMs are abnormal connections between the arteries and veins in the brain. In AVMs, the relatively high pressure blood from the arteries connects directly over to the veins, leading to several problems. The most worrisome issue is that increased pressure in the venous system can lead to rupture of the thin venous wall and result in an intraparenchymal hematoma.

Additionally, it is possible to develop venous congestion and resultant edema in the areas of the brain draining toward the AVM. This may cause neurologic deficit or seizure. Furthermore, due to increased blood flow, aneurysms may develop within the AVM or on nearby arteries. These aneurysms carry a separate additional risk of bleeding. For these reasons and others, patients with cerebral AVMs warrant investigation by a multi-disciplinary team to assess the need for treatment.

Which AVMs should be treated? This is a very complex question and one of significant debate in the current medical literature. Compounding the issue is whether the goal of treatment is to cure the AVM or to achieve some other goal such as decreasing the risk of hemorrhage or symptom control of headaches. For the sake of this discussion, I will assume we're treating for complete obliteration and care.

At the core of the issue is weighing the morbidity and mortality of the natural history of the AVM against the morbidity and mortality of the intervention to cure it, be it surgical or otherwise. In simplistic terms, if the morbidity and mortality of intervention is less than that of the natural history, intervention is indicated. The natural history risk is generally weighed over the lifetime of the patient, so the younger the patient, the greater the risk.

With a surgical or endovascular intervention, the risk is transferred to the upfront risk at the time of surgery. In general, the risk of hemorrhage from an arterial venous malformation is between 1% and 3% per year. Over 15 years, this puts the risk of bleeding at about 25%. If a hemorrhage occurs, the risk of morbidity and mortality is between 40% and 85%. This data is then compared against the expected risk of intervention and a decision is made.

Of course, these data points are the things we focus on in clinical investigation. However, there are a myriad of other concerns for each individual patient, including the patient's functional status, the patient's biases and expectations, as well as patient stress levels. In the clinical setting, all of these factors need to be considered, and the decision to intervene cannot be taken lightly.

Recent controversy in AVM treatment. A recent randomized trial called the ARUBA Study was published investigating outcomes from medical management versus interventional management in unruptured brain AVMs. The study was stopped early, and 223 patients were randomized with a mean follow up of 33 months. In this study, 7.9% of patients in the medical management arm experienced symptomatic stroke or death compared with 35% in the interventional arm.

On the surface, this seems to conclude all unruptured AVMs should be treated medically. However, due to the power of the study, the investigators were unable to stratify based on AVM grade or intervention type, so direct comparisons between AVM subgroups and their natural history where unable to be made. Interestingly, in the ARUBA trial, over 80% had some combination of therapy that did not involve surgery, including 32% having embolization alone.

This does not represent the standard of care in the United States. In fact, embolization alone yields complete resection in only somewhere around 10% of cases. These facts make it reasonable to continue investigation with large prospective cohorts and/or additional randomized trials.

A recent large cohort of over 400 patients published out of Australia found that for grade 1 and 2 AVMs, resection could be achieved with the low morbidity of 1.6%. In this study, morbidity from surgery beat the natural history for these low grade AVMs in less than five months. For grade 3 AVMs and grade 4 to 5 AVMs, the morbidity rose to 15.6% and 60.9% respectively, and comparisons to the natural history were not as favorable. This indicates the importance in considering AVM grade for establishing surgical morbidity.

How are AVMs treated? We have, in general, three options to treat an AVM, and increasingly a multi-disciplinary approach is employed. The three treatment options are microsurgery, endovascular embolization, and radio surgery. The most commonly employed technique for achieving a complete resection of an AVM is pre-operative embolization followed by microsurgerical resection.

Pre-operative embolization helps decrease the blood flow within the AVM nidus, which in turn diminishes its propensity to bleed, as well as helps to define the nidus. This reduces operative time and overall blood loss. Reasons embolization may not be performed prior to surgery are an emergent situation regarding immediate surgical intervention for increased intracranial pressure, or in cases where feeding vessels are not able to be safely catheterized, such as in the case of the lenticulostriate arteries, or when a large vessel gives off multiple delicate small feeders to the arterial venous malformation.

Embolization as a primary modality is rare. This is due to the difficulty in getting a complete AVM obliteration with endovascular techniques and the increased morbidity and mortality associated with attempting this. As always, endovascular techniques continue to improve, and we have seen an increased rate of embolization cure within endovascular techniques, but at present, it is reserved for small, simple arterial venous malformations with one or two arterial feeders in a single draining vein.

Occasionally, a surgically unresectable AVM will be encountered that is associated with an intranidal or prenidal aneurysm. Endovascular techniques may be used as a sole modality in these cases to obliterate the aneurysm in order to reduce the risk of rupture from this entity.

Radio surgery as a single modality is relatively common and can be a safe and effective noninvasive option. In general, radio surgery is reserved for AVMs less than three centimeters in size and is used more often in surgically inaccessible lesions or patients with high surgical risk. Small arterial venous malformations treated with radio surgery have obliteration rates of up to 95% at three years. One drawback of this therapy is that during those three years, the patient is exposed to the risk of AVM rupture. Lastly, I would note it is possible to combine any or all three of these modalities to tackle the unique challenges posed by any one AVM or patient situation.

AVM treatment at Mayo Clinic. Brain AVMs affect somewhere between 100 and 200 to 500 people in the population and are a rare but real cause of stroke. Mayo Clinic in Florida is the first institution in the state to receive the Joint Commission's highest level of certification comprehensive stroke center status. Bearing the certification ensures an institution has the personnel, resources, infrastructure, and organization to handle the full spectrum of stroke, from ischemic stroke due to atherosclerotic disease to hemorrhagic stroke from AVMs, aneurysms, or other lesions. For more information on AVMs, stroke, or the comprehensive stroke center at Mayo Clinic, please visit our website at mayoclinic.org. Thank you.