Dural AV (arterial-venous) Fistulas

BACKGROUND
A dural AV fistula is an abnormal connection (fistula) between an artery and a vein in the dura, the wrapping of the brain. The large amount of blood rushing through this fistula causes higher-than-normal pressures in the drainage outlets of the head, or sinuses, responsible for some of the symptoms noted by patients with this problem.

The dural AV fistula occurs more commonly in females and between the ages of 40-60 years. It is considered an acquired abnormality, and can be associated with a history of sinus obstruction. This obstruction is most commonly due to trauma, infection, surgery to the brain, pregnancy, and clotting disorders. The sinus obstruction can cause a delayed fistula even years later.

RELEVANT ANATOMY
The brain is contained within the skull and is wrapped by a thick membrane, called the dura. Normally, the dura and brain have separate blood supplies, but share a single drainage system, the sinuses. Blood flows from arteries to provide oxygen and nutrients to the brain and drains out through veins. When an abnormal connection exists between the dural arteries and a sinus, high flow and pressure is transmitted into the sinuses and backflows into the brain.

The complex nature of these fistulas makes generalizing about their anatomy and symptoms difficult. Management is dependent upon where and how many arteries supply the fistula, where and how many veins drain the fistula, and the pattern of drainage from the neighboring normal brain.

SIGNS and SYMPTOMS of DISEASE
The symptoms are variable. The location, size and anatomy of the abnormal fistula determines the symptoms that may be seen. These include:

1. Pulsatile tinnitus: a ringing in one or both ears that bounds with the pulse, commonly described as “a whooshing sound”.
2. Headaches.
4. Restricted movement of the eyeball.
5. Any signs that are due to a brain bleed, including face, arm or leg weakness, paralysis, decreased sensation, numbness and tingling, difficulty speaking or understanding, loss of vision, imbalance or lack of coordination.

DIAGNOSTIC TESTS
The usual tests performed include blood tests and imaging studies. Blood tests can be extensive, and can include blood counts (looking for certain abnormalities in the blood cells), bleeding studies (looking for delayed clotting), and drug and medication levels. Initial evaluation may include a CT scan or MRI scan, looking closely at the bone, brain and blood vessel anatomy. These imaging tests may not reveal the abnormality, but can exclude other possible causes that require attention.

The most definitive test is an angiogram, which may be used to completely study the anatomy of all the blood vessels in the head, looking for the abnormal connections. This is an invasive study where a small catheter is inserted from the femoral artery (artery to the side of the groin) into the blood vessels that go to the brain. X-rays are taken while dye (contrast) is injected into the vessels.
TREATMENT OPTIONS

- **Compression.**
  - Direct manual pressure on the feeding arteries and draining veins may be helpful in certain cases only.
  - This is only recommended following careful consideration, and may be dangerous if performed incorrectly or in inappropriate situations.

- **Observation.**
  - This may be appropriate for benign, simple abnormalities causing no symptoms.

- **Surgery for resection of the abnormal connection.**

- **Endovascular therapy.**

- **Radiation.**
  - May be a last option.
  - Little is known about its effectiveness.

SURGICAL TECHNIQUE

The surgical treatment for a fistula involves a skin incision over an area close to the abnormality. A window is made in the bone and the fistula in the dura is identified and resected. At times, the outflow needs to be occluded or resected as well. The bone is secured back in place and the skin sewn closed. The size of the skin incision and bone opening will be individual and be as large as necessary to access and treat the fistula.

The endovascular treatment involves passing a small catheter into the blood vessels near the groin. The catheter is passed up into the head under x-ray guidance. The abnormal connections are identified by injecting dye into the blood vessels and maneuvering into the right spot. The fistula is clogged off using specialized glue, balloons or small metallic coils strategically placed. Once the fistula is occluded, the catheters are removed.

SURGICAL RISKS

There are risks associated with treating a dural AV fistula. Some are inherent to this problem and some are specific to the method of treatment. There is always a risk of stroke and brain bleeds associated with occluding abnormal veins. This is possible if the fistula and vein also helps drain normal brain. The shifting patterns of blood drainage following a fistula treatment can cause strokes or brain bleeds.

Despite careful pre-treatment consideration, removal of the larger abnormal connections can result in smaller ones enlarging and reforming the fistula. This can happen if the small connections are either not seen on pre-treatment angiograms or are not treatable at the first intervention.

Surgery: The fistulas are highly vascular and carry significant amounts of blood. Any manipulation that stirs bleeding can result in rapid life-threatening blood loss. Other risks to surgery include a small risk of infection that may require oral or intravenous antibiotics or even more surgery. This risk is usually minimized by careful surgical technique and antibiotics given around the time surgery.

Endovascular: The potential for incomplete occlusion is present even with initial successful treatment. There is a small potential for a catheter to injure the blood vessels as it passes through.

EXPECTED OUTCOME

The outcomes are dependent upon the complexity of the abnormality and the method of treatment. The normal course for these lesions can either be benign, requiring no treatment and carry no significant risk, or be aggressive with a high risk of brain bleed if left untreated.

The success of either endovascular or surgical treatment is similarly varied, though usually can result in a cure when applied correctly. The other forms of treatment, including compression and radiation, have a much poorer chance of success, but are usually chosen when more routine treatments are not appropriate.
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RELEVANT TERMS
1. hemorrhage: bleed.
2. fistula: an abnormal connection.
3. sinuses: the common drainage system of the head, returning blood back to the heart.
4. dura: the thick membranes that encase the brain, spinal cord and spinal fluid.
5. CT (computerized tomography) scan: an imaging test of the brain using x-rays to look for blood in the inside of the brain.
6. MRI (magnetic resonance imaging): another imaging test using strong magnets to look at brain tissue.
7. angiogram: an invasive test where a catheter is inserted into an artery in the groin and threaded up to the arteries of the brain. A dye is injected and x-ray pictures are taken of the blood vessels.
8. endovascular: a treatment that utilizes the inside of blood vessels as highways to navigate throughout the body toward a target.