Spinal arteriovenous malformations

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Concept

Spinal arteriovenous malformations originate probably by a detention in the normal evolution of the embryonic vessels. By unknown reasons, and about the end of the first month of the embryonic life, the normal differentiation toward arteries, veins and capillaries fails, and non-differentiated vessels persist in the adult life, maintaining the anatomic and physiologic characteristics of the embryonic type.

Frequency

Spinal arteriovenous malformations (S-AVMs) are not frequent. In our experience, they are about 2% of intradural spinal occupying processus, and we have treated one spinal AVM for every dozen cerebral AVMs.

The male/female ratio is about 3/1, and more than half occur at the thoracolumbar level.

Classification

There are three main types of S-AVMs:

a) Dural arteriovenous malformations.
b) Intradural arteriovenous malformations.
c) Cavernous angiomas.

a) Dural arteriovenous malformations, also called dural arteriovenous fistulae, are the more frequent type of S-AVMs, and have the following characteristics:

— Usually, but not always, have low flow.
— Great variety of sizes, from a small venous dilated sinus, drainage of a limited intradural malformation, till huge dural and extradural anomalous vessels in connection with subclavia and vertebral arteries.
— Gradual onset of symptoms.

— Seldom produce subarachnoid hemorrhage.
— Frequent pain and paraparesis.
— Activity increases symptoms.

b) Intradural vascular malformations

They are classified in three types:
b-1) «Juvenile» arteriovenous malformation.
b-2) «Glomus» arteriovenous malformation.
b-3) «Single coil vessel» malformation, also called arteriovenous fistula.

— The «juvenile» AVMs are similar to brain AVMs, and show great variety of sizes, types of vessels, locations, etc. They usually have high flow and cause acute neurological syndromes (sudden paraparesis, subarachnoid hemorrhage).

If anteriorly located inside the spinal cord and bigger than 6 cm., the excision may be hazardous.

— The «glomus» type, not very different from the former except in size, is made up of a nidus of malformed vessels, usually not very long and rather spheric. They are frequently located in the anterior half of the spinal cord and generally supplied by the anterior spinal artery. Venous aneurysms are found not seldom in their vicinity.

— The «single coil vessel» type, or arteriovenous fistula, is the simplest type and the easiest to remove. Consists of a usually long malformed vessel, 1-3 mm. of caliber, surrounded in cases by other smaller vessels, not always easy to say if normal or malformed. Most of them are located in the dorsal part of the spinal cord.

c) Cavernous angiomas.

They are small intramedullary vascular malformations composed by capillary vessels, without nervous system tissue among them, and therefore identical to cavernous angiomas elsewhere. They do not produce subarachnoid hemorrhage and are well detected by M.R.I.
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Pathophysiology

Spinal AVMs produce, probably, increased venous pressure, venous congestion and spinal cord ischemia. They may steal blood from other territories, and — through continuous beating — cause gliosis and atrophy in the vicinity.

Symptoms

Frequent symptoms and syndromes include:
— Subarachnoid hemorrhage.
— Progressive myelopathy.
— Pain.
— Acute neurologic dysfunction.
— Remissions and aggravations.
— Bruit.

Diagnosis

Clinical suspicion leads to M.R.I, as first examination. Myelography is still very useful. Digital arteriography may be interesting.

If the angioma is to be operated, selective spinal angiography is mandatory.

Natural history

Mortality of S-AVMs is not high, but morbidity is heavy. We can estimate than 5 years after the onset of symptoms 50% of patients are disabled and 10 years after, 70%.

Indications of surgery

Concerning surgical treatment of S-AVMs we think it is important to bear in mind the hypocritic motto «primun non nocere».

The indication for surgery flows between the Scila of the grievous morbidity of the angioma natural history, and the Caribdis of the serious risk of surgical excision.

Size, situation, feeding vessels, symptoms, evolution, repeated hemorrhages and neurological status, are factors to take into account for surgical indications. While recent paraparesis may recover completely after surgery, old symptoms or signs not always change.

Generally speaking, the arteriovenous fistula («single coiled type») are frequently amenable to surgical removal, and so are most of «glomerous type» and cavernous angiomas. Yet, with «juvenile» or «brain-like» type of S-AVMs, we should be much more prudent and cautious as far as surgical indication is concerned.

Surgical treatment

Surgical excision should not be attempted if we suspect that further symptoms or signs are likely to appear after the operation, as a consequence of spinal cord damage. We should neither operate immediately after spinal hemorrhage, being advisable to wait until patient's clinical recovery.

Exposure must be sufficient, and microsurgery mandatory after the dura is opened. Evoked potential monitoring has proved to be a useful tool in the control of the excision, particularly in intramedullary deep-seated malformations. Peroperative ultrasonography may also be useful, as indicates the direction of the blood flow inside a vessel (feeding or draining).

During the removal may become apparent that neurological deficit will ensue. In this case may be wise not go further.

Sometimes, the malformation can be excised after careful dissection from the cord. That is usually accomplished in the so-called «single coiled vessel» type, but may be quite difficult in «glomerous type» and even more in the «juvenile type», in which liberal bipolar coagulation of the malformed vessels may be as efficacious as excision, and less dangerous.

In our experience, complete coagulation of the malformation is much easier and safer than removal, and clinical results are far better. In particular cases, coagulation of the arteriovenous communication may be sufficient.

Usually, bipolar coagulation, gelfoam, irrigation, etc. are sufficient for the hemostasis. Clips application is seldom advisable.

References

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