Sinus skeletonization: a treatment for dural arteriovenous malformations of the tentorial apex

Report of two cases

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Two cases of dural arteriovenous malformation of the tentorial apex are presented. Both were treated surgically by means of a sinus skeletonization technique. The operative technique included a combined bioccipital and median suboccipital craniotomy in which the posterior third of the superior sagittal and the straight and bilateral transverse sinuses were skeletonized by incising the falx and the tentorium along the sinuses. Endovascular embolization was used prior to the surgical approach in one case. Clinical and angiographic cure was achieved in both patients, with a follow up of 4 years in the first case and 1 year in the second one. The surgical technique is described in detail.

KEY WORDS • dural arteriovenous malformation • tentorium • embolization • sinus skeletonization

Dural arteriovenous malformations (AVMs) represent 10% to 15% of all intracranial AVMs with approximately 8% dural AVMs originating in the tentorial region. These dural AVMs have a particularly dramatic natural history as they are associated with intracranial hemorrhage in 80% to 90% of cases.

In dural AVMs of the tentorial apex the venous drainage is frequently cortical; this type of drainage is usually related to an increased risk of subarachnoid or intracerebral hemorrhage. The risk of bleeding also becomes higher when these lesions are associated with sinus thrombosis, pial venous channels, and venous displastic aneurysms. The complete surgical excision of the lesion in this group of patients is of paramount importance because residual dural AVMs have a strong tendency to enlarge and recruit pial veins, increasing the chances of future hemorrhage. The combination of embolization and surgery is considered the best therapeutic option for dural AVMs of the tentorial apex.

Case Reports

Case 1

This 45-year-old man was symptom free until 1991, when he experienced the sudden onset of headache, rapidly followed by collapse. A computerized tomography (CT) scan showed a small left-sided thalamic hemorrhage. Cerebral angiography demonstrated a dural AVM involving the apex of the tentorium, supplied by the external carotid artery (ECA) and by meningeal branches from both posterior cerebral artery (PCA) and superior cerebellar (SCA) artery (Fig. 1A–C). Venous drainage was through the vein of Galen, as well as through multiple leptomeningeal veins. The patient was taken to surgery at which time a combined bioccipital and median suboccipital craniotomy and sinus skeletonization were performed. Postoperative angiography showed marked reduction in the size of the dural AVM, with complete occlusion of the branches from the PCA. Nevertheless, a few abnormal dural branches from the ECA still supplied the dural AVM. The patient underwent transfemoral embolization 7 days after surgery and the remaining dural AVM was then completely occluded with 150 to 300-µ particles of polyvinyl alcohol. The patient has remained symptom free since then (Fig. 1D–F).

Case 2

This 48-year-old woman presented in 1994 with a 3-month history of neck pain, dizziness, and right-sided pulsatile tinnitus. An audible bruit and horizontal nystagmus were present at examination. Magnetic resonance imaging showed dilated veins at the level of the quadrigeminal cis-
tern and discrete dilation of the lateral ventricles. An-giographic examination showed a dural AVM involving the apex of the tentorium, which was supplied by meningeal branches of both ECAs and by dural branches from the vertebral arteries. Venous drainage took place through the vein of Galen and straight sinus (Fig. 2A–C). Eight days before surgery the meningeal branches from the ECA that supplied the dural AVM were partially em-boziled with N-butyl-cyanoacrylate. The patient was taken to surgery and a combined bioccipital and median suboccipital craniotomy with sinus skeletonization was performed. In the postoperative period, the patient became drowsy and a CT scan showed moderate ventricular dilation. A ventriculoperitoneal shunt was placed and the patient experienced improvement of her general state. Postoperative cerebral digital angiogram performed 2 months after surgery showed complete obliteration of the lesion (Fig. 2D–F).

**Surgical Technique**

The procedure is performed with the patient in either the semisitting or the prone position. When the semisitting position is indicated, all measures to avoid air embolism must be taken. The patient’s head must be slightly flexed to achieve the best exposure of the falcostentorial region. A large midline incision that extends from the level of the lambdoid suture in the occipital region to C-2 is made. After the muscular planes are dissected, a wide combined bioccipital and median suboccipital craniotomy is performed. Skeletonization of the sinuses begins by the dural opening (Fig. 3). To expose the falcostentorial region in both the supra- and infratentorial compartments, the dura is opened on each side of the superior sagittal and transverse sinuses. Cutting the dura along the superior sagittal and transverse sinuses must be done as close as possible to the sinuses so as to occlude small arterial branches which run in proximity to these sinuses and may feed the dural AVM (see Fig. 1B). After the initial dural opening, the straight sinus is separated out by gently mobilizing the occipital pole with a self-retaining retractor. The dura of the posterior third of the falx cerebri is incised along the superior sagittal sinus and along the straight sinus toward the inferior sagittal sinus, which is coagulated and transected. Then, the junction of the tentorium to the straight and transverse sinuses is coagulated and incised along these sinuses on each side of the exposure. Again, coagulation and division of the falx and of the tentorium cerebelli must be done as close as possible to the sinuses.

The sinus skeletonization technique isolates the arterial component of the dural AVM. Once the varix is discon- nected from the dura it usually thromboses and involutes on its own. Although one might expect that most of the arterial component of the tentorial apex dural AVM converges through the dural covering of the vein of Galen into the vein itself, it is very difficult to predict any anomalous extension of the fistulas. It is well known that if left behind these anomalous vessels have the capacity to re-establish the dural AVM. Thus, we have used large incisions along the sinuses to treat any fistulous connections that might not appear on the angiograms.

**Discussion**

Dural AVMs of the tentorial apex have been named either dural malformations of the vein of Galen by Lasjaunias' or tentorial incisura dural AVM by Awad, et
al. King and Martin postulated that the pathophysiology of tentorial apex dural AVMs is congenital in origin. Obrador, et al., reviewed the world literature in 1975 and found 3% of dural AVMs presenting before the age of 1 year, which strongly supports their congenital origin. However, Rodesch and Lasjaunias believed that all types of dural AVMs are acquired lesions. According to their opinion, these lesions are the result of a venous thrombosis followed by dissolution of the clot and secondary colonization by neovessels. Dural AVMs could appear either spontaneously or following congenital anomalies, trauma, infections, surgery, pregnancy, childbirth, or vascular diseases. Grady and Pobereskin and others also reported on the controversy regarding the origin of dural AVMs. In our two cases, there was no history of head trauma or of previous neurosurgical intervention.

Dural AVMs of the tentorial apex must be aggressively treated because of their potential risk of bleeding. This risk ranges from 80% to 90%, according to King and Martin, and is intrinsically related to the type of venous drainage, as reported by Rodesch and Lasjaunias. Tentorial apex dural AVMs that drain to cortical veins have a higher probability of presenting as hemorrhagic phenomena. The presence of venous displastic aneurysms and pial venous channels can potentiate this risk. Case 1 exemplifies a situation in which thalamic hemorrhage was produced by an arterialized arachnoid draining vein at some distance from the tentorial apex dural AVM. When hemorrhage does occur, medical and early surgical treatment must be instituted to avoid secondary brain injury. The bruit that was observed in Case 2 is very infrequent in dural AVMs of the tentorial apex. It is probably produced by turbulent flow in the nidus and adjacent veins. Disappearance of a bruit, as happened in our Case 2 after surgical and embolism procedures, is considered a clinical criterion of improvement. In both cases, angiography showed a vein of Galen displastic aneurysm that compressed the quadrigeminal plate without clinical manifestations.

Venous-phase angiograms are also important to access...
Sinus skeletonization

Fig. 3. Schematic drawing of the sinus skeletonization technique. The blank dashed lines represent the outer dural incisions and the dark lines the inner incisions. The incisions that follow the contours of the superior sagittal and transverse sinuses externally and the tentorial incision along the straight and transverse sinuses internally are made on both sides of the exposure.

References


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