

Connection Between a Dural Artery and a Dural Vein in a Dural Arteriovenous Fistula of the Cranial Vault

—Case Report—

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Abstract

A 41-year-old man presented with consciousness disturbance and right hemiparesis. Computed tomography showed a hematoma in the frontal lobe. Left carotid angiography showed a dural arteriovenous fistula (AVF) located in the cranial vault, supplied by the left middle meningeal artery, and drained directly into the cortical vein adjacent to the superior sagittal sinus. Emergency decompressive craniectomy and evacuation of the intracerebral hematoma were performed. A red vein was found on the cortex but the location of the arteriovenous shunt was not clear due to severe brain swelling. Two months later, cranioplasty was performed and a part of the dura mater, expected to have been affected by the dural AVF, was resected. Histological examination disclosed thickening of the intima of the middle meningeal artery and a few small veins around this artery. The fistula was clearly demonstrated between the dural artery and the dural vein. The non-sinal type of dural AVF may originate in similar arteriovenous connections to the sinal type.

Key words: dural arteriovenous fistula, non-sinal type, histology

Introduction

Dural arteriovenous fistulas (AVFs) can usually be treated radically because of recent advances in endovascular technique, but the etiology remains unclear. Various hypotheses, including trauma,^{2,7)} surgery,^{10,13)} and dural sinus thrombosis,^{1,6)} have been presented, but the etiology has never been fully explained. Dural AVFs are now thought to be acquired lesions^{1,3,6)} caused by events such as head injury, craniotomy, or sinus thrombosis triggering the opening of physiological dural arteriovenous connections^{8,12)} and resulting in the formation of a dural AVF.

Dural AVFs can be divided into two types according to the draining routes: the "sinal type," which drains into the dural sinus, and the "non-sinal type," which drains directly into the cortical veins without dural sinus involvement. The sinal type frequently involves the cavernous sinus, transverse-sigmoid sinus, and superior sagittal sinus (SSS), and the non-

sinal type occurs in the anterior cranial base, cranio-cervical junction, and cranial vault.

Our previous histological evaluation of dural AVFs involving the transverse-sigmoid sinus found the fistula was located between a dural artery and a dural vein, not between a dural artery and a venous sinus.¹¹⁾ Histological examination of sinal type lesions also demonstrated communication between the dural arteries and crack-like vessels in the sinus wall, suggesting that the crack-like vessels connecting dural arteries and dural veins were an essential characteristics of sinal type lesions.⁵⁾ However, the presence of arteriovenous connections in the non-sinal type remains unclear.

We describe a case of dural AVF involving the cranial vault, in which histological examination of the resected specimen showed the fistula between the dural artery and the dural vein.

Case Report

A 41-year-old man came to our hospital because of consciousness disturbance and right hemiparesis. He had no history of trauma, sinus thrombosis, or

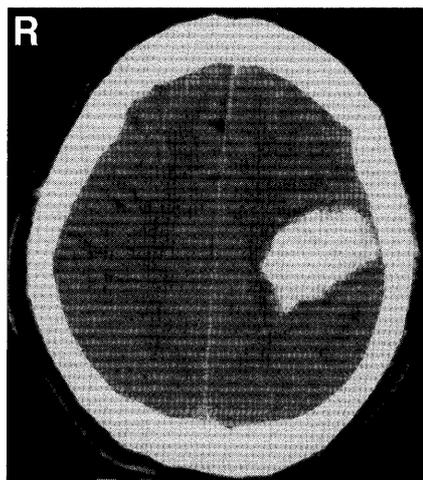


Fig. 1 Computed tomography scan showing an intracerebral hematoma in the left frontal lobe.

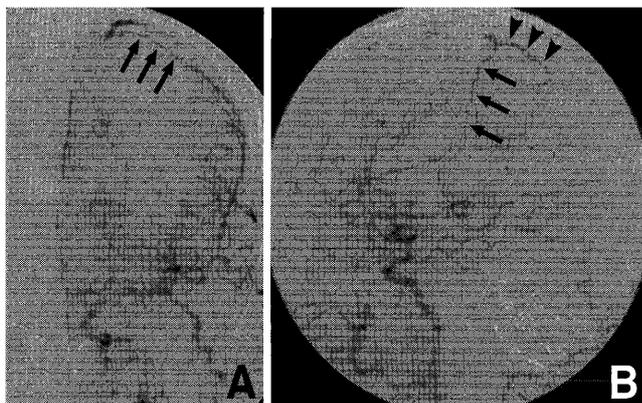


Fig. 2 Left carotid angiograms (A: anteroposterior view, B: lateral view) showing a dural arteriovenous fistula fed by the left middle meningeal artery (arrows) and draining directly into the cortical vein (arrowheads).

craniotomy. On admission, he was drowsy with right hemiplegia and total aphasia. Computed tomography showed a hematoma in the frontal lobe (Fig. 1). Left carotid angiography showed a dural AVF located in the cranial vault. The fistula was supplied by the left middle meningeal artery, and drained directly into the cortical vein adjacent to the SSS (Fig. 2). The draining cortical vein showed marked stasis.

Emergency decompressive craniectomy and evacuation of the intracerebral hematoma were performed. The middle meningeal artery supplying the fistula was cut in the process of dural opening, and the cortical vein appeared red. The AVF could not be identified because of severe brain swelling.



Fig. 3 Photomicrograph of the resected dura mater demonstrating thickened intima with myxoid degeneration in the arterial wall and a few small veins (arrowheads) surrounding the artery. The arteriovenous connection between a dural artery and a dural vein (arrows) is clearly visible. Hematoxylin and eosin stain, $\times 100$.

The cortical vein was cut as close as possible to the arteriovenous shunt. Postoperative angiography revealed no dural AVF. Two months later, cranioplasty was performed and part of the dura mater, expected to have been affected by the previous dural AVF, was resected.

Histological evaluation disclosed thickening of the intima of the middle meningeal artery and a few small veins around this artery. The fistula was clearly demonstrated between the dural artery and the dural vein (Fig. 3). No connection was found between the dural vein and the cortical vein.

Discussion

The present case demonstrated a non-sinal type dural AVF between the dural artery and the dural vein, although the connection of the dural veins and the draining cortical vein remained obscure. A previous case of non-sinal type dural AVF was fed by the superficial temporal arteries and many meningeal branches of the middle meningeal artery, and drained into the cortical veins and the SSS. Histological examination revealed many small arteries and veins in the dura mater, but no AVF.⁹⁾

Physiological arteriovenous shunts have been found in the normal dura. Study of the circulation of the dura mater detected arteriovenous shunts macroscopically,¹²⁾ and study of the microvascular anatomy of the dura mater found arteriovenous shunts in the dura mater near the midportion of the SSS, and arteriovenous shunts connecting the dural arteries and the dural veins. We suggest that the same mechanism accounts for both the sinal type and the non-sinal type. We do not think that the

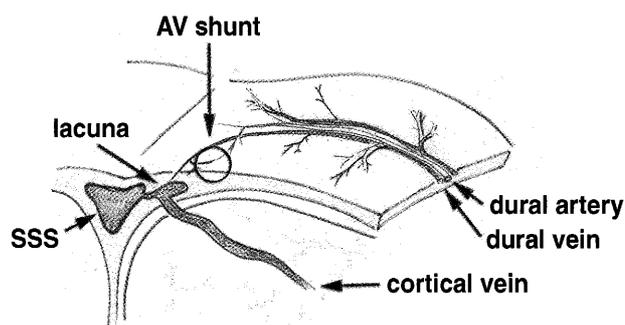


Fig. 4 The schema of a dural artery, dural vein, cortical vein, lacuna, superior sagittal sinus (SSS), and arteriovenous (AV) shunt.

fistula in our case was this type of physiological shunt, because our specimen was cut exactly from the area angiographically identified as the AVF, and the dural artery was observed to be enlarged. In our case, the connection between the dura and the cortical vein was severed in the first operation, so the histological examination did not examine the cortical vein. We speculate that the dural vein connected with this cortical vein to form the AVF.

A review of dural AVFs on the convexity adjacent to the SSS indicated frequent occurrence of this lesion in the convexity,⁹⁾ particularly in the middle third portion where venous lacunae often present.⁴⁾ The venous lacuna tends to occlude when the sinus pressure rises.¹²⁾ The cranial vault dural AVF in the present case may have caused occlusion of the outlet of this venous lacuna resulting in retrograde drainage into the collateral cortical vein. We speculated a schematic view indicating the relation of the dural artery and vein, cortical vein, SSS, and lacuna (Fig. 4).

We believe that the shunt from the dural artery to the dural vein was the essential lesion of this case. Angiography showed that the dural artery seemed to be directly connected with the cortical vein, but we think that the dural artery was in fact in indirect communication with the cortical vein via the dural vein.

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