Transarterial Embolisation of Dural Arteriovenous Fistula Involving an Isolated Segment of the Superior Petrosal Sinus

A Case report

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Summary

This case report illustrates a relatively rare case of dural arteriovenous fistula (AVF) involving direct supply to an isolated segment of the superior petrosal sinus (SPS). Successful transarterial obliteration of the lesion was accomplished with only a liquid embolic agent with long-term angiographic and clinical cure.

Introduction

Dural arteriovenous fistulas are acquired lesions that comprise 10 - 15% of all intracranial AVMs. While the pathogenetic factors involved in their formation have not been completely elucidated, sinus thrombosis is thought to play a prominent role in the formation of some, if not the majority of AVFs. Dural AVFs most commonly occur in the vicinity of the transverse, sigmoid and cavernous sinuses. Involvement of the SPS is distinctly rare.

Case report

The patient is a 62-year-old female who presented with a three-month history of difficulty focusing her eyes, tinnitus, and vertigo with any head movement. Her medical history was significant for degenerative disk disease for which she had undergone a lumbar laminectomy two years prior to presentation. She subsequently developed an extensive spinal epidural abscess, which was drained and treated with antibiotics. She later underwent placement of a Harrington rod for spinal instability. On physical examination, she was alert and fully oriented. Her pupils were equally round and reactive to light. Her extraocular movements were intact and her other cranial nerve examination was unremarkable. On motor testing, her strength was full in all extremities. She demonstrated no gait ataxia.

A magnetic resonance (MR) image of the brain revealed engorged cerebellar hemispheric veins bilaterally but predominantly on the left. A left external carotid angiogram revealed
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Figure 1  Left external carotid angiogram. A) Lateral projection, early arterial phase. There is an AVF involving the isolated segment of the SPS (arrows) that is fed by the middle meningeal and occipital artery branches (arrowheads). B) Towne projection, late arterial phase. Numerous prominent cerebellar hemispheric veins are seen mainly in the left cerebellar hemisphere in retrograde fashion via the SPS (arrows).

an arteriovenous fistula (AVF) involving the left superior petrosal sinus (SPS) (figure 1). Multiple tiny distal branches of the occipital and middle meningeal arteries (MMA) fed the fistula and made connection with the posterolateral aspect of the SPS. There was occlusion of the left sigmoid sinus. The SPS was isolated and drained retrogradely into the markedly dilated cerebellar veins, especially on the left side of the posterior fossa (figure 1B). There was no contribution to the AVF from the internal carotid or vertebral arteries.

Transarterial embolisation was elected a week after diagnostic angiography. A Tracker 10 catheter was initially placed into the distal segment of the left occipital artery. 25% of liquid embolic material, N-butyl-cyanoacrylate (NBCA) mixed with Ethiodol was injected into the distal occipital artery but the fistula could not be obliterated. A significant portion of the dural AVF was still filled via the posterior branches of the MMA. The microcatheter was therefore placed into the main trunk of the MMA. The angiogram showed the dural AVF primarily supplied by 3 branches of the posterior MMA (figure 2). The microcatheter was then advanced into the most distal branch of the posterior MMA after passing two proximal feeders. The angiogram demonstrated several small twigs supplying the fistula at the most posterior part of the SPS (figure 2B). Intraarterial injection of 1% lidocaine was performed. After confirming no adverse effects on the cranial nerves (specifically no facial weakness or numbness, dysarthria, or extraocular muscle weakness causing diplopia), approximately 1 ml of 25% NBCA was slowly injected into the isolated segment of the SPS. The SPS was totally filled with NBCA and the catheter was withdrawn when minimal spillage of NBCA into the hemispheric veins was seen. A control external carotid angiogram revealed complete obliteration of the fistula and all arterial feeders including small branches of the MMA that were not embolised (figure 3). A post-embolisation computed tomographic (CT) scan showed minimal spillage of NBCA into the hemispheric veins but there was no evidence of infarction (figure 4).

The patient's tinnitus resolved within a few days after embolisation. A follow-up four-vessel angiogram with bilateral external carotid injections performed one month later confirmed that the dural AVF remained occluded. There was also decreased prominence of veins over the left cerebellar hemisphere. At two years follow-up she is completely symptom free and a four-vessel cerebral angiogram with bilateral external carotid injections at this time showed no evidence of the AVF. An MR image of the brain also showed minimally engorged hemispheric veins but no abnormality in the cerebellar hemispheres.
Figure 2  Superselective catheterization of left MMA, lateral projection. A) The microcatheter was initially placed in the main trunk of the MMA and the angiogram shows the dural AVF primarily fed by the distal segments of the posterior branch (small arrows). A small proximal twig (arrowhead) is also seen entering into the SPS (large arrow). Numerous prominent cerebellar hemispheric veins are seen. B) After passing two small feeders the catheter was advanced more distally into the most posterior branch of the MMA (small arrow). Arterial twigs (arrowheads) are entering into the fistula at the posterolateral part of the SPS (large arrows). A 25% solution of NBCA mixed with Ethadiol was slowly injected from this point to entirely occlude the isolated SPS.

Discussion

Dural arteriovenous fistulas are acquired lesions that comprise 10 - 15% of all intracranial AVMs\(^1\). While the pathogenetic factors involved in their formation have not been completely elucidated, sinus thrombosis is thought to play a prominent role in the formation of some, if not the majority of AVFs. It is possible that the extensive spinal epidural abscess in our patient may have contributed to occlusion of the left sigmoid sinus with subsequent development of an arteriovenous fistula. Dural AVFs most commonly occur in the vicinity of the transverse, sigmoid and cavernous sinuses. Involvement of the SPS is distinctly rare. In fact, to our knowledge, this case is only the third one reported with direct drainage into the SPS.

The first case was published in 1991 and documented such a case with a varix indenting the brain stem\(^1\). The second was a 63-year-old man with a dural AVF fed by branches from the left internal carotid artery and the left middle meningeal artery. Drainage was via the SPS and sigmoid sinus into the left internal jugular vein. There was also retrograde drainage into the left petrosal vein, lateral mesencephalic vein and basal vein of Rosenthal. Transvenous embolisation was performed via the contralateral occipital sinus\(^2\).

The patient we herein report harbored a fistula that was fed by branches of the left external carotid artery branches. With occlusion of the left sigmoid sinus and internal jugular vein,
a particularly hazardous pattern of venous drainage was noted. There was a considerable amount of reflux into markedly dilated cortical veins of the cerebellar hemisphere. This angiographic finding has been clearly shown to be an important risk factor for venous hypertension and for subsequent haemorrhage. In a meta-analysis of 377 patients with cranial dural AVFs, Awad et al found that patients with leptomeningeal venous drainage were more than 20 times as likely to suffer progressive neurological deterioration or haemorrhage as patients without such drainage.

Treatment options for dural AVF's include transarterial embolisation, transvenous embolisation, and surgical interruption of leptomeningeal venous drainage. A variety of other combined techniques have been utilized including skeletonization of the sinus with transarterial embolisation, and transarterial embolisation with stereotactic radiation or surgery. The goal of transarterial embolisation is to eliminate the fistulous connection(s) of the dural AVF. It tends to have a lower cure rate for lesions involving the transverse and sigmoid sinuses than for those involving the cavernous sinus. Published overall cure rates for transarterial embolisation range from 50-70%. The two main methods of endovascular treatment of dural AVF's, transarterial and the transvenous route, both have their advocates. The transvenous route usually allows for the most direct approach to the fistula. In this case, the SPS was essentially isolated and thus, a transvenous route was not technically feasible. The choice of embolic materials remains somewhat controversial. Particles can be used to alleviate symptoms but there is a high rate of recanalization.

The authors believe that the use of NBCA is associated with a lower recurrence rate. To our knowledge, this is the first reported case of an angiographic and clinical cure of a dural AVF involving an isolated venous sinus only by transarterial injection of NBCA. Complete filling of the isolated dural sinus with diluted NBCA through small arterial feeders was relatively feasible in this case. This technique may not be always successful but it is a useful option in treating dural AVFs involving an isolated dural sinus. The injection of NBCA may also allow the opportunity to occlude the fistulous sites fed by the other unembolised arterial feeders as shown here. This is difficult to accomplish with the use of PVA particles. The use of extremely small particles or NBCA may jeopardize vascular supply to cranial nerves. Pre-embolisation provocative tests using lidocaine and/or amobarbital sodium may be warranted.
References


