

Dural Arteriovenous Fistula with Cortical Venous Drainage: Complete Occlusion with Onyx Embolization

José E. Cohen MD^{1,2}, John M. Gomori MD², Samuel Moscovici MD¹ and Eyal Itshayek MD¹

Departments of ¹Neurological Surgery and ²Radiology, Hadassah University Medical Center, Jerusalem, Israel

KEY WORDS: dural arteriovenous fistula (DAF), Onyx™, cerebral hemorrhage, embolization, endovascular treatment

IMAJ 2011; 13: 705–706

Intracranial dural arteriovenous fistulas with retrograde cortical venous drainage are aggressive lesions associated with a poor prognosis if left untreated [1,2]. The treatment of DAVFs with cortical venous drainage is aimed at occlusion of the entire arterial supply or the venous drainage and can be done surgically, endovascularly, or by a combination of both approaches [1-3]. Onyx™ (ev3, Irvine, CA, USA) is a liquid embolic material that is increasingly used via the arterial route in embolization of arteriovenous malformations and more recently for DAVFs [3-5]. We report a case of successful occlusion of a DAVF with retrograde cortical venous drainage using arterial injection of Onyx.

PATIENT DESCRIPTION

This 35 year old man presented an unremarkable medical history. Six months previously he began to complain of light-headedness together with tension-type headaches and progressive unspecific visual alterations. He was examined by an ophthalmologist who detected bilateral papilledema on routine funduscopy. Visual field examination revealed bilateral enlarged blind spots. The patient was then sent for neurological examination, which was unremarkable. Head computed tom-

ography followed by magnetic resonance imaging demonstrated the presence of a vascular lesion involving the cortico-subcortical left occipital area [Figure A]. Tortuous meningeal and occipital feeders and multiple venous pseudoaneurysms were identified. Diagnostic cerebral angiography revealed the presence of a left occipital DAVF with retrograde cortical venous drainage. The fistula was fed primarily by the posterior branch of the middle meningeal artery and secondarily by other meningeal sources. It was drained directly by enlarged cortical veins presenting multiple aneurysms and indirectly through the lateral sinus [Figure B].

Endovascular treatment: Under general anesthesia a 6 F introducer sheath was placed on the right femoral artery. A 6 F guiding catheter was placed at the left external carotid artery and coaxially a Marathon™ (ev3, Plymouth, MN, USA) microcatheter was guided under a road-mapping technique through the tortuosities of the enlarged posterior branch of the MMA, reaching the fistula [Figure C]. Onyx 18 (ev3) was slowly injected. Reflux occurred several times before Onyx could advance into the fistula site, and at each occurrence the injection was stopped for 1–2 minutes. Onyx was allowed to fill the fistula, other arterial feeders in retrograde direction, and the origin of the draining veins of the fistula.

The Onyx embolization technique allows serial angiographic control of the embolization progress. Complete angiographic occlusion of the dural fistula was evident after a total of 3 ml of Onyx was

injected during 47 minutes, with a single injection technique [Figures D and E].

The patient was extubated immediately after the procedure with no neurological alterations. Headaches were managed with regular medications. A non-contrast head CT performed 12 hours after the procedure showed thrombosis of the multiple venous aneurysms [Figure F]. Two days after the procedure the patient had a generalized seizure that was attributed to thrombosis of the fistula veins. MRI was unremarkable and the patient was discharged under antiepileptic medication.

Funduscopy evaluation performed 20 days after embolization revealed complete resolution of the papilledema. Follow-up MRI-MR angiography performed at 6 and 12 months after treatment, and angiography at 7 months, revealed stable and complete occlusion of the DAVF with no sign of recanalization or parenchymal injury.

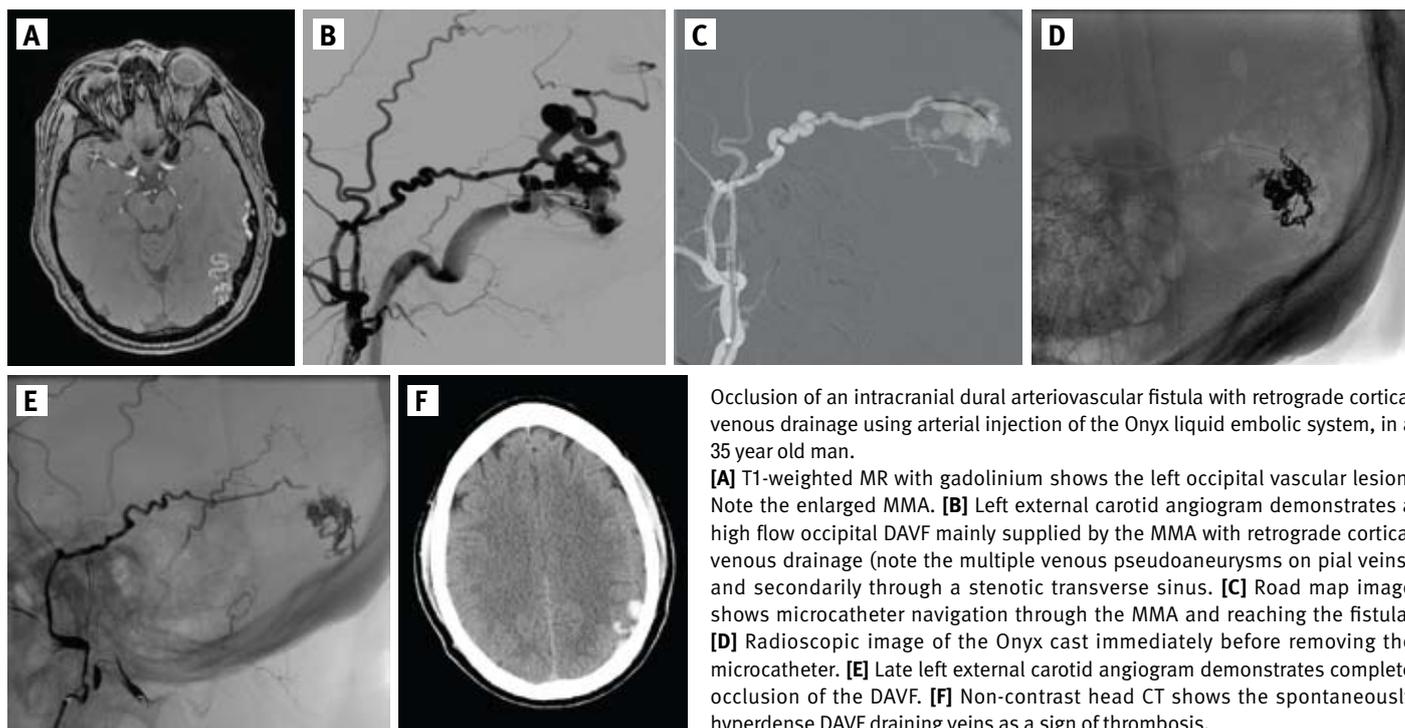
COMMENT

Intracranial DAVFs with retrograde cortical venous drainage are aggressive lesions that can present with intracranial hemorrhage, seizures, progressive neurologic deficit, intracranial hypertension, or dementia [1,2]. Our patient presented with papilledema as a sign of intracranial hypertension secondary to the DAVF-related venous hypertension.

Because of the poor natural history of this type of fistula, treatment is uniformly indicated. Classic therapies include a direct surgical approach to the fistula; endovascular embolization by means of transarterial injection of *n*-butyl cyanoacrylate, particles, or coils; a transvenous approach; or combined approaches [1-3].

DAVF = dural arteriovenous fistula

MMA = middle meningeal artery



Occlusion of an intracranial dural arteriovascular fistula with retrograde cortical venous drainage using arterial injection of the Onyx liquid embolic system, in a 35 year old man.

[A] T1-weighted MR with gadolinium shows the left occipital vascular lesion. Note the enlarged MMA. **[B]** Left external carotid angiogram demonstrates a high flow occipital DAVF mainly supplied by the MMA with retrograde cortical venous drainage (note the multiple venous pseudoaneurysms on pial veins) and secondarily through a stenotic transverse sinus. **[C]** Road map image shows microcatheter navigation through the MMA and reaching the fistula. **[D]** Radioscopic image of the Onyx cast immediately before removing the microcatheter. **[E]** Late left external carotid angiogram demonstrates complete occlusion of the DAVF. **[F]** Non-contrast head CT shows the spontaneously hyperdense DAVF draining veins as a sign of thrombosis.

Staged approaches, involving several embolization sessions with substantial cumulative procedural risk and radiation exposure, have been used in some patients.

The most commonly used embolic agent in neurointerventional procedures is the fast polymerizing liquid adhesive *n*-BCA. The use of *n*-BCA in brain arteriovenous malformations requires experience and skill because intranidal flow and polymerization of *n*-BCA are quick and largely unpredictable.

In 2005 the U.S. Food and Drug Authority approved the Onyx liquid embolic system for the treatment of cerebral arteriovenous malformations. Onyx is less adhesive and polymerizes slowly, allowing prolonged and controlled injection, which seems advantageous in comparison to *n*-BCA [4,5]. Onyx is supplied in a ready-to-use mixture that contains ethylene-vinyl alcohol copolymer, dimethyl sulfoxide, and tantalum. The polymer is dis-

solved in DMSO and is currently available in different concentrations. The lower the concentration of the copolymer, the less viscous the agent and the more distal the penetration. Since its introduction, Onyx has been rapidly adopted as a valuable embolizing agent in most neurovascular centers based on its successful use in the embolization of arteriovenous malformations and DAVFs [3-5].

The use of Onyx for DAVFs with cortical venous drainage is encouraging and this case confirms the good results reported recently by other authors [3]. As with other embolization procedures on the MMA, ischemic damage to the trigeminal and facial nerves is an inherent risk. Damage to these nerves may occur if Onyx reflux extends proximally to the foramen spinosum level and occludes the cavernous and petrosal branches. These complications can be avoided if the operator has adequate anatomical knowledge and experience with the technique.

Corresponding author:

Dr. J. E. Cohen

Dept. of Neurosurgery, Hadassah University Medical Center, P.O. Box 12000, Jerusalem 91120, Israel

Phone: (972-2) 677-7092

Fax: (972-2) 641-6281

email: jcohenns@yahoo.com

References

1. Cognard C, Gobin YP, Pierot L, et al. Cerebral dural arteriovenous fistulas: clinical and angiographic correlation with a revised classification of venous drainage. *Radiology* 1995; 194: 671-80.
2. Cognard C, Casasco A, Toevi M, et al. Dural arteriovenous fistulas as a cause of intracranial hypertension due to impairment of cranial venous outflow. *J Neurol Neurosurg Psychiatry* 1998; 65: 308-16.
3. van Rooij WJ, Sluzewski M. Curative embolization with onyx of dural arteriovenous fistulas with cortical venous drainage. *AJNR Am J Neuroradiol* 2010; 31 (8): 1516-20 [Epub ahead of print].
4. Cohen JE, Gomori JM, Grigoriadis S, Sibly Z, Rajz G. Complete and persistent occlusion of arteriovenous malformations of the mandible after endovascular embolization. *Neurol Res* 2009; 31: 467-71.
5. van Rooij WJ, Sluzewski M, Beute GN. Brain AVM embolization with Onyx. *AJNR Am J Neuroradiol* 2007; 28: 172-7.

n-BCA = *n*-butyl cyanoacrylate

DMSO = dimethyl sulfoxide