Transvenous Onyx embolization of a subependymal deep arteriovenous malformation with a single drainage vein: technical note

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SUMMARY

Cerebral arteriovenous malformations (AVMs) are uncommon. Treatment options include embolization, radiosurgery and surgery, separately or combined, the final goal being complete occlusion of the malformation. We describe the case of a symptomatic small subependymal AVM with a single deep drainage vein previously treated unsuccessfully by radiosurgery and transarterial embolization. The AVM was successfully embolized transvenously using Onyx, achieving complete occlusion in a single treatment session.

BACKGROUND

Cerebral arteriovenous malformations (AVMs) are an uncommon entity with an incidence in the general population estimated at fewer than 1 in 100 000.¹ Treatment options include embolization, radiosurgery and surgery, individually or together, seeking complete occlusion of the AVM. Series treated endovascularly described in the literature have employed an arterial approach,² achieving good results. We describe an uncommon case of a symptomatic small subependymal cerebral AVM with a single deep drainage vein. After radiosurgery and transarterial embolization proved ineffective, the AVM was successfully treated using ethylene vinyl alcohol copolymer (Onyx; ev3, Plymouth, Minnesota, USA) delivered via a transvenous approach.

CASE PRESENTATION

We describe the case of a 45-year-old woman diagnosed with AVM in her home country in 2005 following intraventricular hemorrhage treated by transarterial endovascular embolization using Onyx. The patient was asymptomatic until 2007, when she presented at the emergency room of our hospital with sudden onset headache and disorientation.

INVESTIGATIONS

A CT scan performed on presentation revealed intraventricular bleeding (figure 1A) and cerebral MR angiography showed a small deep left subependymal AVM with a single internal drainage vein. Nidus size was approximately 9 mm (figure 1B). Subsequent arteriography showed that the malformation was fed from the anterior and posterior pericallosal arteries which were extremely narrow and tortuous, making them impossible to negotiate

(figure 2A,B). There was a single deep drainage vein.

The clinical course and patient recovery were satisfactory, with normal neurological examination results and complete resolution of the hemorrhage. The patient was therefore discharged and scheduled for later radiosurgery, bearing in mind the characteristics of the malformation.

Three years after radiosurgery the patient again presented at the emergency room with signs of acute hydrocephaly secondary to intraventricular bleeding. Repeat cerebral arteriography (figure 2C) revealed persistence of the malformation, unchanged since the previous arteriography.

TREATMENT

We discussed the case with the patient and her family who completely ruled out any attempt at surgery, so we raised the possibility of embolization using a transvenous approach in an attempt to cure the malformation completely and thus avoid further episodes of bleeding. All parties agreed to assume the risks attached to this treatment modality.

The procedure was carried out in the vascular angiography room (Philips Integris V3000) under general anesthesia without systemic heparinization by means of dual catheterization through the right femoral vein and the left femoral artery. A transvenous approach was effected through the right femoral vein using a 6 Fr Neuron guide catheter (Penumbra, Alameda, California, USA) which was advanced without complication until it was positioned at the junction of the left lateral sinus and the torcular herophili. A microcatheter (Marathon; ev3 Neurovascular, Plymouth, Minnesota, USA) was then advanced through the deep venous system of the brain to the AVM nidus (figure 3A).

At our hospital most AVMs are embolized via a transarterial route using Onyx-18. However, in this case our intention was to achieve only minimal reflux, so we decided to inject Onyx-34 instead. Reflux was kept to a minimum during injection by a slow constant controlled injection rate which succeeded in completely occluding the AVM nidus and the proximal segment of the drainage vein (figure 3B). When serial angiography from the left vertebral artery demonstrated complete angiographic occlusion of the AVM (figure 3C,D), the microcatheter was withdrawn under slow steady traction without complication.

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Figure 1 (A) Emergency axial CT scan showing diffuse intraventricular hemorrhage. (B) MR angiography showing a small subependymal arteriovenous malformation with a single deep drainage vein.

The patient was placed in the ICU under special controlled hypotension for 48 h, intubation for 24 h and decreasing doses of corticoids for 4 days.

OUTCOME AND FOLLOW-UP

The period immediately after the procedure was complication-free and, on follow-up at 6 months, the AVM remained completely occluded and the neurological examination was normal.

DISCUSSION

The cumulative risk of AVM bleeding is 2–4%, rising to 6% in the first year after the first hemorrhage.³

Good progress in endovascular treatment methods has been made in recent years as a result of the introduction of new embolization agents such as Onyx, which can bring about complete occlusion or help reduce nidus size in preparation for radiosurgery⁴ using a transarterial approach.²

Our case involved a deep symptomatic Spetzler–Martin grade II AVM for which radiosurgery had proved ineffective after the AVM had first been treated endovascularly using an arterial

approach,⁵ with poor results because the malformation could not be reached distally via the feeder arteries. Following these treatments which had failed to occlude the AVM and, once surgery had been ruled out, it was decided to attempt to occlude the AVM completely endovascularly using a transvenous approach.⁶

To our knowledge very little has been written about this approach route, mainly because of the risk of vein rupture during catheterization, vein rupture on withdrawing the micro-catheter after embolization, occlusion of the vein resulting in nidus rupture and hemorrhage or venous thromboembolism.^{7–9}

The largest series published to date described five cases of malformation (three grade III AVMs and two grade IV AVMs), achieving complete occlusion in four of the five cases without intra- or periprocedural complications.⁹

The need to stop arterial antegrade flow temporarily in order to avoid reflux of the embolization material before it reaches the nidus during injection has been described.⁹ However, on consideration of the characteristics of Onyx, a material suitable for slow protracted injections, we did not think it necessary to

Figure 2 (A, B) Digital subtraction angiography showing narrow tortuous afferent vessels from the posterior (A) and anterior (B) pericallosal arteries, indicating that a transarterial approach was not a viable option for endovascular treatment. The cast of the previous embolization through the afferent vessels is visible. (C) Arteriography performed 3 years after radiosurgery showing a persistent malformation.

Figure 3 (A) Digital subtraction angiography, anteroposterior projection. Injection from the drainage vein confirms the proper distal positioning of the microcatheter with no sign of complication during cannulation. (B) The microcatheter is visible inside the guide catheter positioned in the left lateral sinus. The Onyx cast of the earlier embolization which failed to reach the arteriovenous malformation (AVM) nidus is also visible. (C) The Onyx cast is visible in the AVM nidus and part of the drainage vein after withdrawal of the microcatheter. (D) Angiography from the left vertebral artery confirms complete occlusion of the malformation.

block flow in any of the arteries feeding the malformation. In the case described here, the approach was quick and easy and we were able to advance the microcatheter all the way to the nidus. After Onyx injection there was only minimal reflux that did not prevent removal of the catheter.

Since the main fear in using this approach in AVMs is the risk of hemorrhage in the nidus during a transient time of intranidal hypertension because of poor outflow as the vein becomes obstructed by the liquid embolic material, larger series are needed to be able to assess the safety and results of this method.

We are reporting this case with a view to adding one more option to our arsenal of AVM treatments, reserved for cases in which the other treatment options are unfeasible or have proved unsuccessful, basically in AVMs <3 cm with a single drainage vein that is not greatly dilated. We hope that more reports and reviews may help consolidate this treatment option in future.

Learning points

- Treatment options for cerebral arteriovenous malformations (AVMs) include embolization, radiosurgery and surgery, separately or combined, the final goal being complete occlusion of the malformation.
- Good progress in endovascular treatment methods has been made in recent years, mainly as a result of the introduction of new embolization agents such as Onyx.
- Transvenous embolization should be reserved for cases in which the other treatment options are unfeasible or have proved unsuccessful, basically in arteriovenous malformations <3 cm with a single drainage vein that is not greatly dilated.

Contributors All the authors have contributed to the concept, authorship, revision and final review of the manuscript.

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