Case Studies

Balloon-Occlusion Catheter Onyx Embolization of a Spinal Dural Arteriovenous Fistula Presenting with Subarachnoid Hemorrhage in a Pediatric Patient

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Objective: Spinal dural arteriovenous fistulas (DAVFs) are insidious pathologies that, if left untreated, harbor potentially devastating consequences to the central nervous system. Spinal DAVFs are rare in the adult population and exceedingly uncommon in the pediatric population. In this report, we describe a spinal DAVF in a 3-year-old child whose initial presentation is subarachnoid hemorrhage (SAH). Balloon-test occlusion and balloon–catheter-assisted embolization of DAVF have not been previously described, and their advantages over alternative embolic and surgical techniques are discussed. *Methods:* We performed a literature search on MEDLINE/PubMed to review current reports describing the epidemiology, clinical presentation, and treatment of spinal DAVFs. In this report, we describe a spinal DAVF in a 3-year-old child whose initial presentation is SAH. *Results:* A spinal DAVF was diagnosed after deciding to image not only the brain but also the spine. Using a balloon-occlusion catheter, we confirmed that the DAVF arterial feeding vessel could be safely embolized. We then proceeded to effectively treat the DAVF with balloon–catheter-assisted Onyx-18 embolization. *Conclusion:* Based on our report and an analysis of the literature, we propose that pediatric patients presenting with nontraumatic SAH should undergo at least a magnetic resonance imaging of the brain and cervical spine as part of their initial workup. In addition, we describe a balloon-occlusion catheter embolization technique that allows not only excellent embolic penetration of the fistula but also prevention of microcatheter reflux and lessening of the need for a tedious plug-and-stack technique. **Key Words:** Spinal dural arteriovenous fistula—pediatric subarachniod hemorrhage—Onyx embolization—balloon-occlusion catheter.

Introduction

Dural arteriovenous fistulas (DAVFs) are arteriovenous (AV) shunts within the dura mater of the dorsal nerve root sleeve that drain into the perimedullary venous plexus.[1] Their classic presentation is a subtle, slow-onset paraparesis (40%), back pain or radiculopathy (28%), and sphincter disturbances that are exacerbated by activity.[1-5] The occurrence of a spinal dural AV shunt in the pediatric population is an exceedingly rare event, with only 3 reports in the literature to date (Table 1).[2,6,7]

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Table 1. *Presentation, diagnostic algorithm, treatment, and outcomes for dural arteriovenous fistulas in the pediatric population*

Study	Age, sex	Presentation	Treatment	Outcome
Stephan et al[6]	3-year-old M	Asymptomatic patient with hemorrhagic hereditary telengectasia who underwent screening CT chest	Embolization of fistula via right L2 radiculomedullary artery with a 3:1 mixture of NBCA and ethiodiol	Intact with no clinical recurrence at 10-month follow-up
Kenning et al[2]	14-year-old F	Fever, lethargy, SAH, IVH, HCP, delayed paraplegia from spinal hemorrhage	EVD, spinal subdural hematoma evacuation, single Onyx embolization, VPS	Persistent paraparesis with neurogenic bladder, no recurrence of DAVF on MRI at 9-month follow-up.
Poisson et al[7]	8-month-old M	Acute back pain followed by subacute flaccid paraplegia and bladder dysfunction and history of hereditary hemorrhagic telangiectasia	Repeated embolizations of all different pedicles	Acquired ability to walk but with continued bladder disturbances requiring percussion and Oxybutinin, length of follow-up not reported

Abbreviations: CT, computed tomography; DAVF, dural arteriovenous fistula; EVD, external ventricular drain; F, female; HCP, hydrocephalus; IVH, intraventricular hemorrhage; M, male; MRI, magnetic resonance imaging; NBCA, N-butyl cyanoacrylate; SAH, subarachnoid hemorrhage.

Intradural spinal AV malformations and fistulas of the cervical spine may present with subarachnoid hemorrhage (SAH).[8] However, due to their low flow and predominant location in the thoracolumbar spine, SAH from a spinal DAVF is exceptionally uncommon.[2,3,9]

The treatment of spinal DAVFs is changing with the proliferation of neuroendovascular techniques. Several authors now advocate endovascular treatment as first intention, with surgery reserved when endovascular treatments fail.[4] Prior studies document Onyx as an effective treatment option for spinal DAVF.[1] Disadvantages of Onyx include a tendency to reflux, greater expense, unproven long-term durability with cases of DAVF recanalization,[10] necessity for compatible catheters, and tedious plug formation. To our knowledge, there are no existing reports of balloon-occlusion catheter Onyx embolization of a spinal DAVF.

Case Report

A 3-year-old previously healthy female presented after an episode of unresponsiveness precipitated by 8 days of headache, nausea, vomiting, and fatigue. Computed tomography of the head identified SAH with mild ventriculomegaly. The neurological examination demonstrated partial right abducens paresis and unsteady gait.

Magnetic resonance imaging (MRI) of the brain and spine was ordered. Cranial imaging was negative; however, spinal imaging demonstrated an arterial–venous fistula. Large-flow voids suggestive of dorsal perimedullary venous congestion were observed with myelocompression from an ectatic vein approximating at T9 (Fig 1).

A cerebral and spinal angiogram was performed. The cerebral angiogram was normal, but the spinal angiogram at the left T11 injection demonstrated an enlarged, tortuous radiculomedullary artery draining into an engorged perimedullary venous plexus with a fistula point in the neuroforamen. The artery of Adamkiewicz was identified with no involvement of the fistula.

A balloon was advanced into the feeding arterial pedicle. The balloon was inflated in the dural branch of the radiculomedullary artery and somatosensory evoked potentials (SSEPs) were recorded. No change in SSEP was observed. With the balloon inflated, Onyx was injected. The balloon was deflated, the catheter withdrawn, and the patient awakened from anesthesia in stable neurological condition (Fig 2).

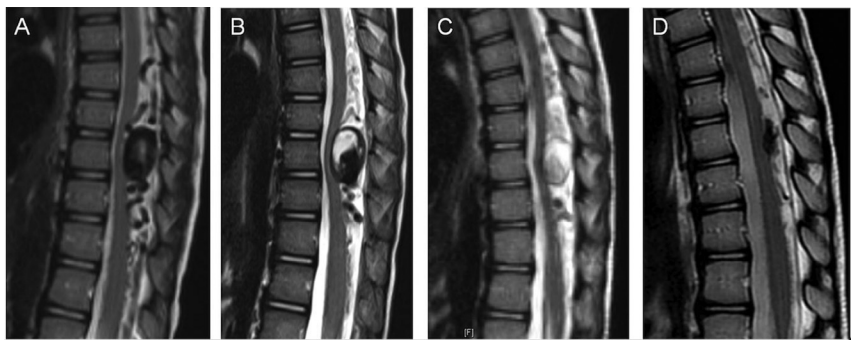

Figure 1. *Sagittal T2 sequence spinal MRI demonstrating thrombosis of venous varix and reduction in size of the arterialized venous plexus at presentation (A), 2 days post embolization (B), 2 months post embolization (C) and 6 months post-embolization (D). Abbreviation: MRI, magnetic resonance imaging.*