Radial Nerve Palsy following Endovascular Embolization of an Arteriovenous Malformation

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Abstract

Background Arteriovenous malformations (AVMs) are commonly treated using endovascular techniques. Previous nerve palsies after embolization have been reported as isolated case reports, none of which affected the forearm.

Case Description A case of acute, transient neuropathy of the radial nerve following embolization of a forearm AVM is described. The patient, an otherwise healthy 27-year-old man, began having symptoms of superficial radial nerve (SRN) and posterior interosseous nerve (PIN) palsies immediately following endovascular embolization. He underwent decompression of the radial nerve within 5 days and was found to have direct compression of the PIN and SRN. The patient recovered completely at the time of his 7-month follow-up.

Literature Review Few cases of nerve palsy after endovascular embolization have been reported in the literature. Many are intracranial, but rare instances of peripheral nerve palsy have been reported, including two sciatic nerve and four digital nerve palsies after endovascular embolization. No cases of peripheral nerve palsy in the forearm have been reported.

Keywords

- arteriovenous malformation
- nerve decompression
- peripheral nerve palsy
- vascular embolization

Clinical Relevance We recommend careful consideration of surrounding neural elements at risk for palsy prior to endovascular embolization and detailed discussion with the patient during the informed consent process.

Embolization of arteriovenous malformations (AVMs) is a common, proven technique with relatively low morbidity and mortality.^{1–3} Acute, transient neuropathies after endovascular treatment of vascular malformations have been reported, both for peripheral and intracranial AVMs.^{4–9} In the literature, two sciatic nerve and four digital nerve palsies after endovascular embolization have been reported.^{6–8}

Endovascular embolization is a common procedure performed by vascular surgeons. Given the functional deficit that is present after a nerve palsy, any damage to a peripheral nerve after an endovascular embolization must be avoided.

This report describes a case in which a patient had an acute dense posterior interosseous nerve (PIN) and superficial radial nerve (SRN) palsies after embolization of a large vascular malformation at the elbow and forearm.

Case Report

A healthy 27-year-old right-hand-dominant man presented with a 2-year history of a large pulsatile mass and second smaller mass on the medial forearm of his right arm that began increasing in size and pain for several weeks prior to presentation. Radiographs revealed a healed fracture of the distal ulnar shaft at the level of a soft tissue mass (► **Fig. 1**). An ultrasound was performed on the mass and the patient was diagnosed with a right ulnar artery high-flow AVM that was excised 2 weeks later by a vascular surgeon at our institution (► **Fig. 2**). He was neurovascularly intact at that time, but continued to have pain after his initial surgery. Magnetic resonance angiography was performed on the first post-operative day, and the patient was diagnosed with a large

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Fig. 1 Preoperative radiographs showing soft tissue irregularity at the distal forearm as well as proximal forearm.

high-flow type A AVM of the brachial artery at the elbow extending to the distal forearm (**Fig. 3**).¹⁰ A repeat ultrasound was performed on the elbow the following day confirming the AVM at the elbow (**Fig. 4**). A week after the index surgery, the patient underwent endovascular ablation of the brachial AVM using Onyx liquid embolic agent (ethylene vinyl alcohol) and coils (**Fig. 5**).

After this procedure, the patient was noted to have hand weakness. Physical examination was notable for an inability to extend his wrist and fingers along with decreased first dorsal webspace sensation; triceps function was intact. Five days later, the patient had an open brachial AVM and aneurysm excision by vascular surgery, in addition to PIN and SRN exploration and decompression by the senior author of this case report. The malformation was found to be compressing the SRN as well as the PIN. The previously embolized AVM was noted between the superficial and deep heads of the supinator muscle, and the PIN was located just deep to the AVM. Both nerves were in continuity.

At 2-, 4-week, and 3-month follow-up, the patient continued to be symptomatic. During his hospitalization and his recovery period, he used a cock-up wrist extension splint, worked with occupational therapy, and was given a home exercise program to maintain joint range of motion. At his 7-month follow-up, he

Fig. 2 Preoperative ultrasound showing right ulnar artery arteriovenous malformation.

had regained his ability to extend his wrist and fingers, and his sensation returned to baseline. He returned to full work and activities without further complaints.

Discussion

We report a case of PIN and SRN palsies after embolization of an AVM in the elbow and proximal forearm. Both nerves were noted to be in continuity upon surgical exploration during the AVM resection; however, there was direct compression of neural elements caused by the mass effect of Onyx. The patient's symptoms resolved spontaneously within 7 months.

Fig. 4 Preoperative ultrasound showing antecubital arteriovenous malformation.

Fig. 3 Magnetic resonance angiography showing the patient's arteriovenous malformation.

Fig. 5 Radiograph after ulnar artery arteriovenous malformation resection and Onyx embolization of arteriovenous malformation, with superimposed superficial radial and posterior interosseous nerves.

A thorough understanding of the anatomy of peripheral nerves and their relation to major vascular structures is essential when treating peripheral vascular malformations. Cases of cranial nerve palsies have been reported in the literature after vascular malformation embolization.^{4–6} However, very few

authors have reported peripheral nerve palsies after extremity AVM embolization, and nerve palsy involving the forearm has not been reported in the past.^{6–8} In ►**Table 1**, reported cases of nerve palsy after AVM embolization are shown. Of five patients with peripheral nerve palsies after extremity AVM

Table 1 Previously reported cases of neuropathy following embolization of vascular malformation

Article	Location of vascular malformation	Nerve involved	Result
Nyberg et al (2013) ⁴ (patient 1)	Intracranial	Facial nerve	Resolved at 4 mo
Nyberg et al (2013) ⁴ (patient 2)	Intracranial	Facial nerve, trigeminal nerve (mandibular branch)	Facial nerve symptoms resolved at 4 mo, trigeminal nerve symptoms resolved at 2 mo
Pei et al (2010) ⁵	Intracranial	Hypoglossal nerve	Not specified
Ozgüçlü and Kiliç (2009) ⁶	Buttock	Sciatic nerve	Not specified
Türkbey et al (2011) ⁷	Pelvis	Sciatic nerve	Significant improvement after 6 mo
Park et al (2011) ⁸ (four patients with “transient nerve palsy”)	Single or multiple fingers	Digital nerve(s)	Not specified, but all noted to have resolved within 2–6 mo

embolization, significant improvement or complete resolution of the nerve deficits were reported in four. In one case, the authors did not report follow-up. These findings are similar after intracranial AVM embolizations, with three reported cases of nerve palsy showing complete resolution and one with unspecified clinical outcome.^{4–8} In this particular case, the patient had dense palsy of the radial nerve with radiographic evidence of direct compression of the PIN and SRN. Given the close proximity of the nerve to the area of embolization, we elected to proceed with decompression of the radial nerve and removal of the emboli. The PIN and SRN were both visualized and noted to be directly compressed by the Onyx emboli. In addition, the discretion and visualization of the nerves was very challenging due to difficulty obtaining hemostasis during the procedure.

We recommend that patients undergoing embolization for high-flow AVM in close proximity to major peripheral nerves be advised on the potential risk of nerve palsy. In this particular case, both branches of the radial nerve were directly compressed by the Onyx emboli. Although most nerve palsies reported in the literature resolved, there is little evidence to suggest that they all will resolve. Given the mass effect of the Onyx emboli and the immediate nerve palsy following embolization decompression of the PIN and SRN is the most prudent way of maximizing return of function. We feel that delayed decompression will be more challenging and may reduce the chance of nerve recovery as there are few guidelines as to the timing for nerve decompression and delay in decompression may reduce the chance for recovery. The early exploration and decompression not only gives the patient a defined path to recovery but it also removes the direct compression from the injured nerve. Hence, we recommend removal of the Onyx emboli in the setting of a dense nerve palsy following embolization.

Conflict of Interest

None.

References

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