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Case Report

Endovascular embolization combined with anterior cervical corpectomy for treatment of cervical spinal dural arteriovenous fistula

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ABSTRACT

Background: The two main treatments for spinal dural arteriovenous fistula (SDAVF) include microsurgical occlusion or endovascular embolization (i.e., the latter alone has high recurrence rates). Here, we combined both strategies to treat/obliterate a cervical SDAVF more effectively.

Case Description: A 34-year-old male presented with a marked decline in mental status attributed to an infratentorial subarachnoid hemorrhage. The left vertebral angiogram revealed a ruptured, low cervical SDAVF. He underwent successful occlusion of the spinal fistula utilizing super selective catheterization and endovascular embolization (i.e., utilizing Onyx-18 for the obliteration of target arteries). Due to significant SDAVF accompanying vessel recruitment/complex angioarchitecture, we additionally performed a C5 anterior corpectomy/fusion to afford direct access and complete surgical SDAVF occlusion. Three and 6 months later, repeated angiograms confirmed no recurrent or residual SDAVF.

Conclusion: We successfully treated a low cervical SDAVF using a combination of endovascular embolization and direct surgical occlusion through an anterior C5 corpectomy with a fusion approach.

Keywords: Anterior cervical approach, Corpectomy, Endovascular embolization, Hybrid strategy, Spinal dural arteriovenous fistula

INTRODUCTION

Spinal dural arteriovenous fistulas (SDAVFs) consist of abnormal connections between meningeal arteries and dural venous sinuses or subarachnoid veins that lack a capillary network.[3,6] Approximately 80% of SDAVFs are located between the T6 and L2 levels, with 2% found at the level of the foramen magnum; low cervical spinal fistulas are exceedingly rare.[3] Direct microsurgical occlusion of these fistulas is the gold standard and has the highest success rates.[9] Alternatively, performing minimally invasive endovascular embolization has a higher risk of recurrence.[8] Here, we successfully combined both treatments in a 34-year-old male

who presented with a subarachnoid hemorrhage attributed to a low cervical SDAVF; he underwent both preoperative embolization and direct surgical occlusion requiring a C5 anterior cervical corpectomy/fusion approach. Three- and 6-month postoperative angiograms demonstrated no recurrent or residual SDAVF and surveillance angiography will be performed once a year to screen for SDAVF recurrence.

CASE DESCRIPTION

For 6 days, a 34-year-old male experienced a mild headache, irritability, cervical/dorsal pain, and numbness of the upper extremities. He then acutely became obtunded, requiring intubation, sedation, and hospital transfer. The non-contrast cranial computed tomography scan revealed an infratentorial subarachnoid hemorrhage [Figure 1]. Suspecting a ruptured aneurysm of the posterior circulation, the patient underwent a left vertebral artery angiogram. It revealed a low cervical, intradural, extramedullary, ventral, ruptured SDAVF fed from the left anterior C6 radicular artery, along with a pial aneurysm, with retrograde drainage through the anterior spinal venous plexus [Figure 2]. Reevaluation 24 h after cessation of sedation, the patient had a Glasgow coma scale of 15 and demonstrated 2+/5 strength in the right upper extremity with bilateral C6/C7 paresthesias.

1st endovascular embolization of the left C6 radicular artery

The patient first underwent endovascular embolization of the left C6 radicular artery utilizing Onyx-18. However, the SDAVF was also being supplied through the right C5 radicular artery, with retrograde flow to the left C6 radicular artery, persistent retrograde drainage to the anterior spinal venous plexus, and an intranidal aneurysm [Figure 3].

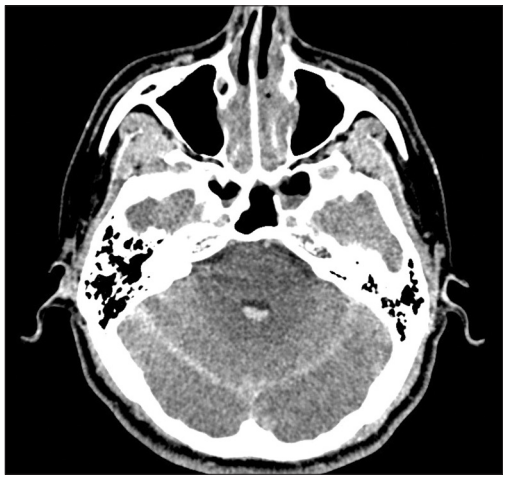

Figure 1: Axial plane of non-contrast cranial computed tomography scan on admission. The study revealed the presence of infratentorial subarachnoid hemorrhage, as well as ventricular irruption, with evidence of bleeding in the fourth ventricle.

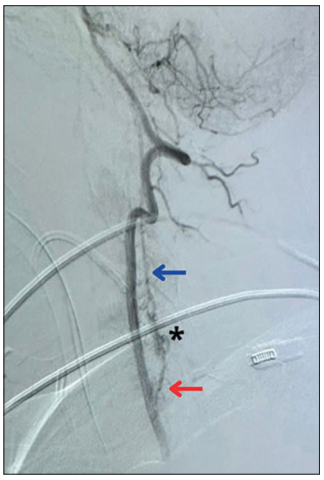

Figure 2: Lateral view of left vertebral artery angiogram. The study revealed an arteriovenous shunt (black asterisk) inside the cervical canal, fed by the left C6 radicular artery (red arrow) and with retrograde venous drainage through the anterior cervical venous plexus (blue arrow).

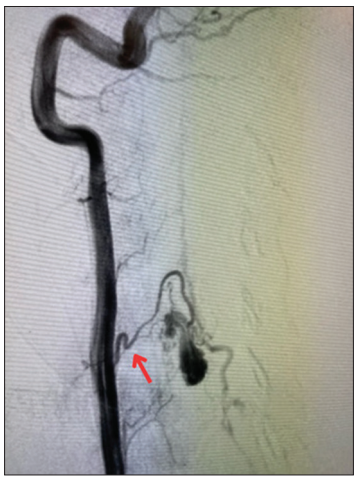

Figure 3: Anteroposterior view of embolization of the left C6 radicular artery. After successfully occluding the target artery with Onyx-18, we evidenced continuous arterial flow from the right C5 radicular artery (red arrow).

Super selective catheterization of the right C5 radicular artery

During the same procedure, super selective catheterization of the right C5 radicular artery was performed through the right vertebral artery (i.e., a microcatheter with a microwire was accessed approximately 2 cm in front of the ostium of the right C5 radicular artery). A 4 × 20 mm extra-compliant balloon was placed in the V2 segment of the right vertebral artery to keep the microcatheter in place and prevent the reflux of the embolic agent [Figure 4a]. Onyx-18 was slowly injected, and we obliterated the spinal fistula [Figure 4b].

Complete surgical occlusion of the spinal fistula through a C5 corpectomy

The preoperative embolization facilitated direct visualization and occlusion of the spinal fistula and intranidal aneurysm through an anterior C5 corpectomy/fusion (i.e., including placement of an interbody spacer and lordotic plate) [Figures 5a-d].

Postoperative course

Postoperatively, the patient had 3+/5 strength in the right upper extremity. Angiograms repeated 3 and 6 months later confirmed complete occlusion of the SDAVF, and the patient will remain under angiographic surveillance every year, looking for SDAVF recurrence.

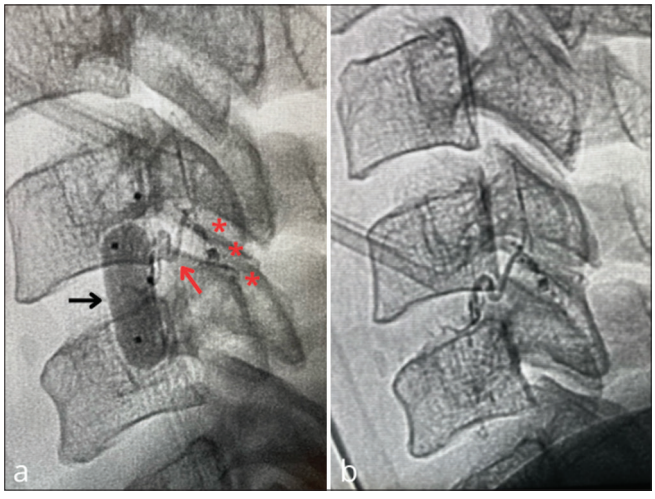

Figure 4: Super selective catheterization of the right C5 radicular artery. (a) shows the balloon (black arrow) at the V2 segment of the right vertebral artery and the microcatheter placed in the target artery (red arrow); casts of Onyx-18 are seen (red asterisks). (b) right vertebral artery angiogram confirmed obliteration of the fistula.

DISCUSSION

Natural history of SDAVF

Spinal fistulas typically enlarge over time.[1] Cenzato *et al.*[2] suggested that 50% of patients with untreated SDAVF become severely disabled within 3 years after the original onset of symptoms. Here, a 34-year-old male who had sustained an infratentorial subarachnoid hemorrhage attributed to a low cervical SDAVF underwent embolization (i.e., left C6, right C5 radicular arteries), followed by direct surgical occlusion (i.e., through an anterior C5 corpectomy approach). For typical SDAVFs involving a nerve root sleeve, a laminectomy or laminoplasty may provide sufficient exposure for direct SDAVF ablation.[4]

Efficacy of direct surgical occlusion of SDAVF

One meta-analysis quoted a 98% success rate for direct surgical occlusion of SDAVF versus a much lower 46% rate

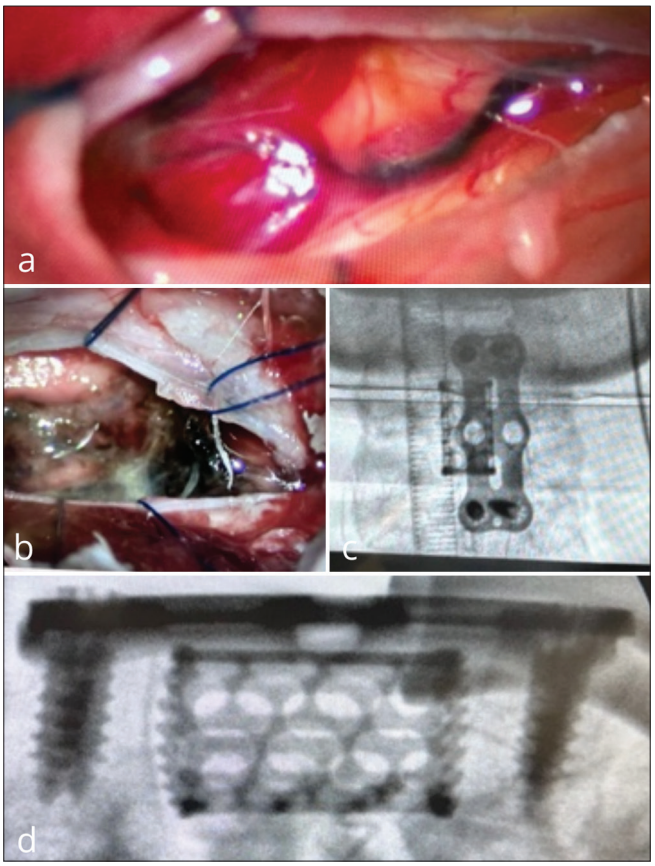

Figure 5: Direct occlusion of the low cervical, ventral, spinal dural fistula. (a) shows anterior cervical approach, and (b) shows the C5 corpectomy. In postoperative anteroposterior (c) and lateral (d) X-ray views, the interbody spacer and the anterior lordotic plate are seen.

Table 1: A literature review of the treatment of SDAVF.

Author, journal, and year	Study design and number of patients	Location of SDAVF	Surgical occlusion		Endovascular embolization	
			Number of patients	Success rate	Number of patients	Success rate
Cenzato *et al.*[2] Neurosurg Focus 2012	Retrospective analysis of 65 patients	C: 1 (1.5%) T: 46 (71%) L: 18 (27.7%)	55	100%	10	70%
Koch *et al.*[5] J Neurosurg Spine 2017	Retrospective analysis of 34 patients	C: 2 (5.8%) T: 20 (58.8%) L: 12 (35.2%)	14	100%	20	75%
Lee *et al.*[7] Sci Rep 2021	Retrospective analysis of 71 patients	C: 11 (15.5%) T: 45 (63.4%) L: 12 (16.9%) S: 3 (4.2%)	15	100%	56*	66.1%
Oh *et al.*[8] Neurospine 2021	Case series of 38 patients	C: 5 (13.1%) T: 24 (63.1%) L: 9 (23.6%)	4	100%	34	38%
Steinmetz *et al.*[10] Neurosurgery 2004	Meta-analysis of 532 patients**	NR	263	97.9%	74	46%
Xiao *et al.*[11] Front Neurol 2023	Case series of 55 patients***	100% at the foramen magnum	18	100%	35****	85.7%

*14 patients required secondary surgery, and the success rate was 92.9%. **195 patients were treated with a combined strategy but the success rate is not reported. ***2 patients refused treatment. ****5 patients required secondary surgery, and the success rate was 100%. SDAVF: Spinal dural arteriovenous fistula, C: Cervical, T: Thoracic, L: Lumbar, S: Sacral, NR: Not reported

of success with embolization.[10] Total surgical occlusion of SDAVF prevents recurrence,[1,9] but complications approach 5–15% (i.e., including pseudomeningocele, spinal instability, and/or increased neurological impairment).[4] Alternatively, although endovascular embolization is less invasive, it has higher recurrence rates.[5,8]

Potential benefits of the hybrid approach to SDAVF

Few studies in the literature utilized both endovascular embolization and simultaneous direct surgical occlusion of SDAVF [Table 1]. Lee *et al.*[7] treated 14 patients with SDAVF utilizing initial embolization with secondary surgery and obtained a success rate of 92.9%. Five out of 55 patients were initially treated with endovascular embolization and then required secondary surgery due to recurrence of SDAVF. Here, our utilization of both endovascular and direct occlusion enabled us to treat a lower cervical SDAVF in a 34-year-old male effectively.

CONCLUSION

We successfully treated a low cervical SDAVF in a 34-year-old male utilizing both preoperative embolization and direct surgical occlusion through an anterior C5 corpectomy approach.

Ethical approval

The Institutional Review Board approval is not required.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent.

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Nil.

Conflicts of interest

There are no conflicts of interest.

Use of artificial intelligence (AI)-assisted technology for manuscript preparation

The authors confirm that there was no use of artificial intelligence (AI)-assisted technology for assisting in the writing or editing of the manuscript and no images were manipulated using AI.

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