CASE REPORT

Ruptured distal AICA pseudoaneurysm presenting years after vestibular schwannoma resection and radiation

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SUMMARY

Distal anterior inferior cerebellar artery (AICA) pseudoaneurysms are very rare lesions. Although cases have been previously reported, only a few have been reported as a result of vestibular schwannoma (VS) radiation, none have been reported as a result of VS resection, and only one has been reported as treated with parent vessel occlusion (PVO) with n-butyl cyanoacrylate (nBCA). We report a case of a 65-year-old man with a history of right-sided VS surgery and radiation who presented years later with a ruptured pseudoaneurysm of the distal right AICA and was treated with endovascular PVO using nBCA. The aneurysm was completely obliterated and the patient had no worsening of symptoms or neurological exam. The case illustrates a very rare complication of VS surgery and radiation as well as an effective treatment for distal AICA aneurysms.

BACKGROUND

Distal anterior inferior cerebellar artery (AICA) aneurysms are rare lesions.^{1–3} Although a number of cases have been previously reported,^{3–32} very few were as a result of vestibular schwannoma (VS) radiation,^{15 23–25 32} none were as a result of VS resection, and only one was reported as treated with parent vessel occlusion (PVO) with n-butyl cyanoacrylate (nBCA).²⁸

CASE PRESENTATION

A 65-year-old man with a past medical history of a pituitary adenoma, hypothyroidism, and a right-sided VS after surgery and radiation presented to our institution with a Hunt–Hess grade II subarachnoid hemorrhage (SAH) with a predominance of blood in the posterior fossa on the right side

(figure 1). Of note, the patient had previously undergone two resections of the VS at an outside institution 13 and 6 years prior to presentation. The patient also underwent stereotactic radiotherapy following the second operation. On examination the patient was mildly drowsy and had a residual House–Brackman 4 right facial along with right-sided hearing loss, facial numbness, and dysmetria.

TREATMENT

The patient was taken directly for digital subtraction angiography (DSA) which demonstrated a pseudoaneurysm of the distal right AICA. The aneurysm arose off the rostral branch in the premeatal portion of the lateral pontine segment (figure 2). A 5 Fr Envoy catheter (Codman Neurovascular, Raynham, Massachusetts, USA) was placed in the left vertebral artery. A 1.2 Fr Magic microcatheter (Balt Extrusion, France) was used to catheterize the rostral branch of the right AICA. Given that the pseudoaneurysm arose distal to brainstem perforators and there was a well sized right-sided posterior inferior cerebellar artery (PICA) and superior cerebellar artery (SCA), the decision was made to perform a PVO of the rostral branch of the right AICA at the level of the pseudoaneurysm using Trufill nBCA (Codman Neurovascular; figure 3). Control angiography following the PVO demonstrated complete obliteration of the pseudoaneurysm as well as patency of the proximal portion and caudal branch of the AICA (figure 4).

OUTCOME AND FOLLOW-UP

The patient tolerated the procedure well and woke without any new neurological deficits. Over the

Figure 1 (A–C) CT head axial images: there is a diffuse subarachnoid hemorrhage with a predominance of blood in the posterior fossa on the right (arrow).

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Figure 2 Digital subtraction angiography, left vertebral injection, anteroposterior (A) and lateral (B) views. (C) Right anterior inferior cerebellar artery (AICA) microinjection, oblique view. A pseudoaneurysm (arrowhead) is present in the distal right AICA. The pseudoaneurysm arises from the rostral branch in the premeatal portion of the lateral pontine segment. There is a large sized right posterior inferior cerebellar artery (PICA). BA, basilar artery; LA, left AICA; SCA, superior cerebellar artery; LS, left SCA; LV, left vertebral artery; M, meatal portion; RA, right AICA; RP, right PICA; RS, right SCA.

following 24–48 h he developed worsening headache and communicating hydrocephalus, requiring placement of a right frontal external ventricular drain. A follow-up CT head 10 days after intervention demonstrated a right cerebellar and brachium pontis stroke (figure 5). The patient did not undergo MRI. He ultimately required placement of a right frontal ventriculoparietal shunt. He had a short stay in acute rehabilitation and is now doing well at home.

DISCUSSION

The AICA originates most commonly from the lower third of the basilar artery, usually as a single trunk, and courses through the central part of the cerebellopontine angle near cranial nerves VI, VII, and VIII. It then courses near the internal auditory canal and foramen of Luschka and then curves around the flocculus on the middle cerebellar peduncle. The AICA usually bifurcates into a rostral and caudal branch near the cranial nerve VII/VIII complex. The rostral trunk sends branches laterally along the middle cerebellar peduncle to the cerebellopontine fissure and adjoining part of the petrosal surface while the caudal trunk sends branches to the inferior part of the petrosal surface, including a part of the flocculus and the choroid plexus. Perforating arteries arise from the AICA and supply the brainstem, choroid plexus, and cranial nerves, including the labyrinthine, recurrent perforating, and subarcuate arteries. The segments of the AICA include the anterior pontine, lateral

pontine, flocculopeduncular, and cortical segments. The lateral pontine segment contains premeatal, meatal, and postmeatal portions, depending on the relationship to the internal auditory canal.³³

AICA aneurysms are rare lesions that account for 0.1–0.5% of all intracranial aneurysms.^{1–3} The majority of AICA aneurysms originate at or very close to the AICA–basilar artery junction,^{1 34} leaving distal AICA aneurysms, such as the one reported here, as an extremely rare entity that has mostly been reported in case reports and series.^{3–32} The most common location for distal AICA aneurysms is the meatal segment.³ Occasionally, distal AICA aneurysms arise secondary to hemodynamic stress associated with cerebellar arteriovenous malformations or hemangioblastomas.^{9 21 30} Distal AICA aneurysms are more frequently atypical in nature (eg, dissecting) compared with aneurysms at more common locations in the intracranial circulation.^{11 14 16 19 25 28 31 32}

Pseudoaneurysm formation in our case probably resulted either from direct trauma during surgery and/or radiation effect. Although these aneurysms have been reported following stereotactic radiation for VS,^{15 23–25 32} there are no reports following surgical resection. Radiation-induced aneurysms are very rare and typically occur from the aneurysm wall rather than branch points.^{15 23–25 32} The mechanism of radiation-induced aneurysm formation has not been fully elucidated but has been suggested to result from endothelial damage,^{24 32} atherosclerotic changes in the intima, collagenous fibrosis with loss of smooth muscle cells in the media, and macrophage infiltration within the intima and/or media.²⁵

Distal AICA aneurysms often present with SAH,^{3–5 7 9 10 12 14–16 18 24–29 31} but can also present with other symptoms of mass effect such as headache,^{13 19} vomiting,¹⁹ dizziness,¹¹ ataxia,^{9 19} vertigo,⁹ hearing loss,^{4 10 13 19} facial paresis,^{4 13} trigeminal neuralgia,⁶ and seizures.^{8 19} Axial imaging with CT angiography, MRI, or MR angiography should be obtained, but occasionally the aneurysm can be occult¹⁰ or mistaken for other cerebellopontine angle or intracanalicular masses.^{11 13} DSA is the gold standard for diagnosis but has been reported to be negative at first and then subsequently positive,¹² reinforcing the importance of repeat DSA in the setting of an angiographically negative SAH.

A variety of both surgical and endovascular techniques have been used for distal AICA aneurysms. The most commonly used overall treatment is surgical clipping with AICA preservation.^{3–6 8–10 12 18 21 22 27} Other surgical approaches include surgical trapping^{3 9 13 18} and occipital to AICA

Figure 3 Embolization, right anterior inferior cerebellar artery (AICA) microinjection, oblique view. Embolization was performed with Trufill n-butyl cyanoacrylate (nBCA) with occlusion of the pseudoaneurysm (arrowhead) and rostral branch of the AICA (arrow) with a small amount of distal embolism (star).

Figure 4 Digital subtraction angiography, left vertebral injection, anteroposterior (A) and lateral (B) views. The distal right anterior inferior cerebellar artery (AICA) pseudoaneurysm is no longer seen. There is patency of the proximal right AICA as well as the caudal branch of the AICA. BA, basilar artery; LA, left AICA; SCA, superior cerebellar artery; LS, left SCA; LV, left vertebral artery; RA, right AICA; PICA, posterior inferior cerebellar artery; RP, right PICA; RS, right SCA; RV, right vertebral artery.

Figure 5 CT head, axial images. CT obtained 10 days after intervention demonstrates an established stroke in the right cerebellar hemisphere (arrow) and right brachium pontis (arrowhead) without any obvious changes in the brainstem.

bypass.²⁹ The most commonly used endovascular treatment is PVO with coils.^{7 9 14 16 26 28} Other endovascular approaches include endovascular coiling of the aneurysm with AICA preservation^{14 31} and PVO with nBCA,²⁸ although it should be noted that one case of coiling without PVO resulted in incomplete aneurysm occlusion, repeat SAH, and the ultimate need for a PVO.¹⁴ A combination approach of occipital to AICA bypass plus endovascular PVO has also been used.¹⁹

The major concern with either surgical or endovascular PVO is stroke and subsequent neurological deficit. Zager *et al*⁹ recommended that aneurysms distal to the brainstem perforators could be safely surgically trapped without bypass or obliterated with endovascular PVO, although the latter carries a risk of retrograde thrombosis to the proximal AICA segment. On the other hand, Santillan *et al*²⁸ reported two patients who underwent endovascular PVO and both had worsening neurological deficits post-procedure. One patient had a fusiform aneurysm of the meatal loop and developed hearing loss and ataxia after the PVO. The patient was reported to have a full neurological recovery at 10 months post-procedure. The second patient had an aneurysm distal to the meatal segment, developed truncal ataxia with a defined brachium pontis infarction and only had a partial long-term recovery. The other cases of endovascular PVO resulted in either no neurological deficits or hearing loss only.^{7 14 16 26}

Endovascular PVO was an attractive option in our case given the history of two prior surgical resections in this region, the fact that the patient already had neurological deficits secondary to the previous VS resection, the distal AICA location of the pseudoaneurysm, and the large sized PICA and SCA. It should be stated, however, that the follow-up CT did demonstrate a

new stroke following the PVO and, had the patient not already had a neurological deficit, the occlusion would likely have resulted in a new deficit.

Learning points

- ▶ Distal anterior inferior cerebellar artery (AICA) aneurysms are rare lesions that are frequently atypical and often present with subarachnoid hemorrhage (SAH).
- ▶ There are a variety of both surgical and endovascular techniques that can be used for these lesions depending on the patient's vascular anatomy as well as operator experience.
- ▶ Parent vessel occlusion with n-butyl cyanoacrylate (nBCA) is a reasonable option for AICA aneurysms that arise past the brainstem in patients with good collateral circulation.
- ▶ Although there have been a few previous reports of AICA pseudoaneurysm formation after vestibular schwannoma (VS) resection, this is the first report following VS resection.
- ▶ For patients who present with SAH after intracranial surgery or radiation, atypical aneurysms should be kept in mind.

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Competing interests JM is the National/International PI/Co-PI for the following trials: THERAPY (PI), FEAT (PI), AMERICA (PI), LARGE (Co-PI), POSITIVE (Co-PI). He is on the Steering Committee for the MAPS trial. He is a consultant to Lazarus Effect, Reverse, Pulsar, Edge Therapeutics, Medina. He is an investor with Blockade

Medical and Medina. AB has the following conflicts of interest: grants/research (Microvention), consulting fees (Microvention, Sequent Medical, Scientia Vascular, Blockade), ownership/partnership (Sequent Medical, Rapid Medical, Scientia Vascular, Blockade, Medina Medical), and royalties (Angiodynamic). JF is a consultant to Microvention.

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