

Revascularization for failed carotid artery stenting in a patient with a rare vertebral artery anomaly

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ABSTRACT

There is a growing cohort of patients requiring complex revascularization for failed carotid artery stenting. This revascularization can be complex in patients with coexisting supra-aortic vascular anomalies. Aberrant origin of the vertebral artery (VA) is an example of such an anomaly. Although VA anomalies are rare, their occurrence is of significant importance in endovascular and open vascular procedures. We report a case of a 78-year-old man with rare VA anomaly, whose left internal carotid artery ostium was inadvertently covered during a carotid artery stenting procedure. We discuss the carotid artery revascularization in this patient as well as the relevant literature. (*J Vasc Surg Cases and Innovative Techniques* 2018;4:178-80.)

The goal of carotid artery revascularization is to prevent the event or recurrence of stroke. Within the last three decades, carotid artery stenting (CAS) has emerged as a less invasive alternative to open surgery.^{1,2} Enthusiasm for CAS in both community and academic medical centers has resulted in a cohort of patients requiring intricate carotid artery revascularization after failed stenting.³

Interestingly, some patients with carotid artery stenosis also have congenital vascular anomalies. There have been reports of successful endovascular and open surgical treatment of carotid artery stenosis in patients with coexisting supra-aortic vascular anomalies.^{4,5} However, reports on open carotid revascularization for failed CAS in this subset of patients is absent in current literature. We present a case of failed CAS and internal carotid artery (ICA) entrapment in a patient with a rare vertebral artery (VA) anomaly and the subsequent revascularization. The patient gave his consent and agreed to have his case details and images published in this case report.

CASE REPORT

A 78-year-old man with symptomatic bilateral carotid artery stenosis underwent left CAS by the cardiology service. After

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the procedure, the patient experienced intermittent right-sided weakness and speech difficulty. He then underwent a right CAS 1 month after the left CAS by the same cardiology service. Four hours after the right CAS procedure, the patient developed right-sided hemiparesis and global aphasia. On suspicion of left hemispheric stroke, a noncontrast head computed tomography scan was ordered followed by magnetic resonance imaging of the brain. The head computed tomography scan showed no abnormalities, but magnetic resonance imaging of the brain showed acute lacunar infarcts within the left parietal lobe. The interventional neuroradiology team was immediately consulted for a possible acute stroke intervention. The team performed a carotid angiogram that demonstrated the presence of a malpositioned stent compromising blood flow to the left ICA. According to the angiography report, there was a persistent hypoglossal artery coming off the left ICA and the stent extended from a segment just above the left common carotid artery (CCA) bifurcation to the midcervical segment of a persistent hypoglossal artery (Fig 1). In retrospect, this interpretation was incorrect. Furthermore, there was no evidence of in-stent restenosis or thrombosis on angiography. The patient was subsequently referred to our unit for further management.

We reviewed the patient's intracranial and extracranial neurovasculature on the angiogram and discovered that the anomalous vessel described as the "persistent hypoglossal artery" was actually an aberrant left VA arising from the left CCA (Fig 1). The blood vessel presumed to be the left ICA was actually the continuation of the left CCA. After we reviewed the patient's history and diagnostic imaging, consent was obtained for open surgical intervention (to restore adequate blood flow through the left ICA). Intraoperatively, we appreciated this left VA anomaly. There was a high bifurcation of the left CCA with a normal take-off of the external carotid artery. The bifurcation was above the hypoglossal nerve, with the CCA dividing into a large VA laterally and a very small ICA medially. The stent was located within the left VA and the left CCA. The midportion of the stent covered the left ICA origin, essentially trapping the vessel and preventing blood

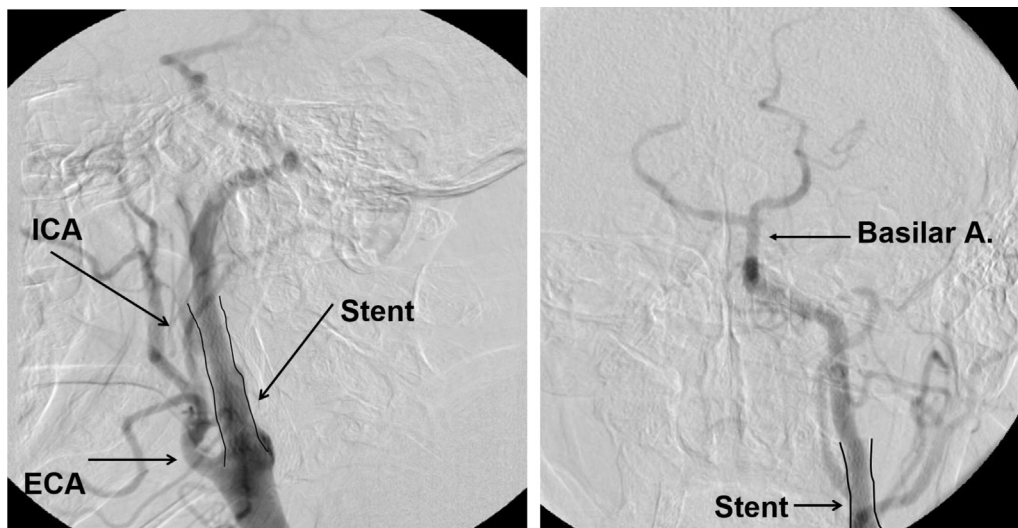


Fig 1. Preoperative angiogram (done by the neurointerventionist) showing the vessels coming off the left common carotid artery (CCA). The stent is visualized in the left vertebral artery (VA). A, artery; ICA, internal carotid artery; ECA, external carotid artery.

flow. Exposing these blood vessels involved a tedious dissection. We performed a left external carotid artery to ICA bypass, using a reversed saphenous vein graft. The completion angiogram demonstrated good blood flow through the left ICA (Fig 2). The immediate postoperative period was complicated by a neck hematoma that was promptly explored and evacuated. The patient was then transferred to complete an inpatient rehabilitation program and his functional status improved; he regained motor function in his right upper and lower limbs, but he still experienced difficulty swallowing. At his follow-up visit 4 months later, the patient did not exhibit any new neurologic deficit and his carotid duplex scan was essentially normal. On the most recent follow-up at 5 years, the patient has equal muscle strength bilaterally and no speech impairment. He is now able to eat soft diet with honey-thickened liquids.

DISCUSSION

Anatomic variants of the VA origin are not common; the estimated prevalence is 6%.^{6,7} In general, anomalies of the right VA origin are less frequent than those of the left VA.⁸ The most common VA anomaly is direct aortic origin of the left VA, with a prevalence of 2.4% to 5.8%, in autopsy studies, and about 2.5% in cerebral angiography studies.^{7,9} The occurrence of a left VA arising from the left CCA is extremely rare; only 3 cases have been reported before this case report.¹⁰ The VA typically arises from the posterior-superior aspect of the first part of the ipsilateral subclavian artery, above the level of the first rib. Between the fifth and eighth weeks of intra-uterine life, the VA develops from the longitudinal anastomoses between the cervical intersegmental arteries. Alterations in these embryonic events account for the anatomic variations in the VA.

Anomalous VA origins are usually discovered incidentally as they are mostly asymptomatic.¹¹ However,

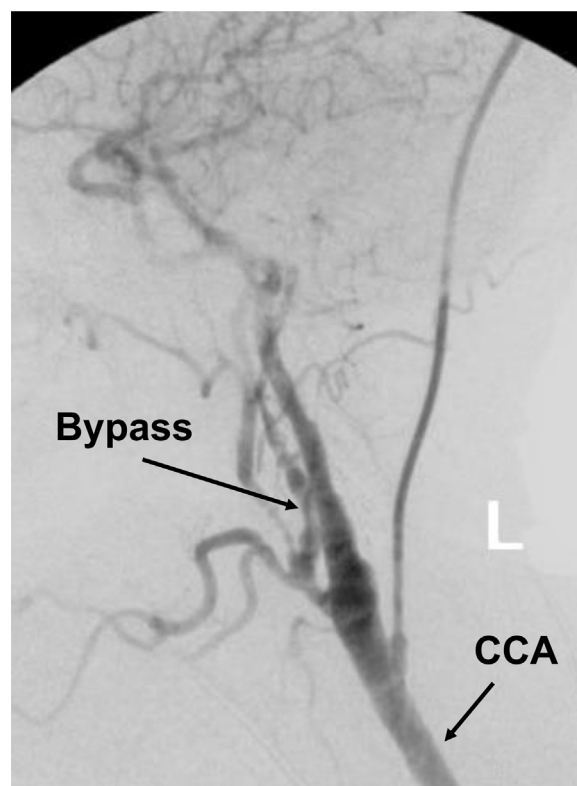


Fig 2. Postoperative angiogram showing the same vessels coming off the left common carotid artery (CCA) after bypass operation. The catheter was placed in the left CCA.

Gabrielli et al¹² reported a case of ataxia and vertigo attributed to a left VA anomaly. Also, an aberrant VA origin may be associated with arterial dissection, because the a longer extracranial course may predispose the vessel wall to shear stress, resulting in dissection.¹³ It can easily be deduced from this case report that to

avoid complications, detailed preprocedural evaluation (computed tomography angiography, magnetic resonance angiography, four-vessel angiography) assessing both extracranial and intracranial neurovasculature is necessary.¹² In this instance, the VA anomaly was misinterpreted on the initial angiogram, probably owing to its rarity. Some authors note that the anomalies of VA and other supra-aortic vessels can be difficult to diagnose; defining the exact configuration of these anomalies may be challenging, even with conventional angiography.^{5,14}

The medical literature is replete with articles on revascularization for failed CAS. Although many authors limit their discourse to treatment of in-stent restenosis,^{15,16} others broadly discuss the treatment of various complications of CAS.^{17,18} Treatment for failed CAS typically involves endovascular reintervention or open surgery. Open surgical treatment options include carotid endarterectomy with stent explantation and carotid artery bypass. Carotid endarterectomy requires a shorter operating time and is more commonly used; however, the procedure is difficult to perform in the presence of high carotid bifurcation, extensive ICA stenosis, carotid kinking, postradiation arteritis, and fibrous restenosis.^{19,20} Carotid artery bypass is a safe and durable option in situations where carotid endarterectomy appears risky.^{18,20} This case was unique considering the VA anomaly, the high carotid bifurcation, the unusually small caliber of the left ICA, and the fact that the indication for revascularization was ICA entrapment (not in-stent restenosis). We, therefore, decided to perform a carotid bypass on this patient. Although we used a saphenous vein as the conduit, some authors prefer prosthetic grafts because they are concerned about kinking.²¹ Many authors, however, report no significant difference between the use of a good quality vein and a prosthetic graft as carotid bypass conduits.^{22,23}

CONCLUSIONS

VA anomalies are of significant importance in surgical and angiographic procedures when they occur. Comprehensive preprocedural assessment of vascular anomalies is advised to avoid complications. Carotid bypass grafting is an effective treatment option for failed CAS in patients considered high risk for carotid endarterectomy and in patients with coexisting vascular anomalies.

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