CASE REPORT

Basilar stroke from a persistent hypoglossal artery

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SUMMARY

Occlusion of the basilar artery can be treated with endovascular thrombectomy, although the results have not been well studied. Persistent fetal cerebrovascular anatomy can lead to unusual presentation of carotid atherosclerotic disease and can be a barrier to successful mechanical thrombectomy if not recognized. This case presents a rare persistent carotico-basilar anastomosis which resulted in basilar occlusion via the persistent hypoglossal artery and coincident absence of contralateral vertebral arterial access due to a left vertebral artery terminating in the left posterior inferior cerebellar artery. Preoperative recognition of this anatomy afforded by review of cross-sectional imaging was critical to success during this emergent procedure.

BACKGROUND

Although several randomized controlled trials and a revised set of guidelines ushered in a new era of endovascular thrombectomy for acute ischemic stroke, there continue to be limited data on the management of acute vertebrobasilar occlusion. In clinical practice, the devastating effects of vertebrobasilar stroke without treatment have typically led to attempts at endovascular treatment.¹

In the fetal circulation the trigeminal, hypoglossal, and pro-atlantal arteries form anastomoses between the carotid artery and the basilar artery for approximately 1 week.² These typically regress, but are well described as potential persistent vessels with a prevalence of 0.2% (trigeminal), 0.03–0.09% (hypoglossal), and 0.02% (pro-atlantal).^{3–5} The persistence of these fetal anastomoses can sometimes be associated with hypoplasia of the vertebral arteries and unusual patterns of cerebrovascular disease.⁵

We describe a case at the clinical intersection of persistent fetal cerebrovascular anatomy and acute ischemic stroke from acquired adult vasculopathy.

CASE PRESENTATION

A woman in the seventh decade of life with ischemic cardiomyopathy from a myocardial infarction 4 years previously, a baseline ejection fraction of 35% and an automated implanted cardiac defibrillator but without a history of atrial fibrillation presented at 07:00 hours on awakening with nausea, dizziness, and dysphasia (National Institutes of Health Stroke Scale (NIHSS) score 4). She received aspirin with partial symptom resolution and was admitted for observation, but subsequently developed left hemiparesis followed by decreased consciousness. At 23:00 hours, approximately 24 hours from last-known-well, she was transferred to an

endovascular-capable center and was emergently intubated when noted to be bradypneic with hypoxic respiratory failure and with a non-reactive right-greater-than-left anisocoria (NIHSS V22).

INVESTIGATIONS

Interval non-contrast CT head and CT angiography (CTA) demonstrated right mesencephalic–diencephalic hypodensity and basilar occlusion (figure 1A, B). Despite early infarction, potential morbidity from the additional at-risk territory supported endovascular intervention and she was taken for thrombectomy.

On close review of the imaging in preparation for the thrombectomy, the morning CTA demonstrated basilar occlusion. Inspection of the vertebrobasilar circulation demonstrated a robust left cervical vertebral artery (VA) which primarily supplied the left posterior inferior cerebellar artery, with a diminutive distal V4 segment to supply the basilar artery. The right VA was diminutive from the brachiocephalic origin and terminated at the C1 vertebral level at the cervical muscular branches and did not contribute to the intracranial supply (figure 2A). Rather, there was a dilated branch of the right internal carotid artery arising at approximately the C2 level and entering the hypoglossal canal, providing primary supply to the basilar artery (figure 2B). This was consistent with the embryological carotid–basilar hypoglossal anastomosis: a persistent hypoglossal artery.

TREATMENT

This finding was critical for access considerations, since neither the right nor the left VA would have permitted deployment of the microcatheter and stent-retriever in the basilar artery. Revascularization was achieved by two passes of aspiration, first within the basilar trunk and then within the right P1 segment, through an ACE64 catheter (Penumbra, Alameda, California, USA) (figure 3A, B) with proximal support from an 8 Fr reinforced sheath in the right common carotid artery and a NeuronMax 088 (Penumbra) guide catheter in the right internal carotid artery. No adjunct pharmacotherapy was applied. Histopathological analysis showed that the retrieved embolus was a fibrous tan rubbery tissue fragment with histologically acellular eosinophilic material consistent with subacute thrombus. Atherosclerotic disease was visible at the right carotid bifurcation as the presumed source of this type of embolus (figure 3C).

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Figure 1 (A) Non-contrast CT head demonstrates hypodensity of the right thalamus and mesencephalon consistent with early infarction (white arrow). (B) Oblique coronal CT angiogram (CTA) shows a basilar occlusion (white arrow) with a primary right intradural vertebral artery supply and a left vertebral artery primarily feeding the left posterior inferior cerebellar artery (white arrowhead). Close inspection of the origin of the right vertebral artery demonstrates a lateral cervical course (bold arrow) outside the transverse foramen of the cervical vertebrae. Although this could also be consistent with an aberrant course of the vertebral artery, other cuts of this reconstruction show that the vertebral artery traverses the hypoglossal canal (black arrow) after originating from the posteromedial aspect of the right internal carotid artery. There is also a diminutive left vertebral artery connection with the basilar artery (black arrowhead). (C) Three-dimensional reconstruction of CTA shows the basilar cut-off (white arrow) with a primary right intradural vertebral artery supply and primarily feeding the left posterior inferior cerebellar artery (white arrowhead). Close inspection of the origin of the right vertebral artery demonstrates a lateral cervical course (bold arrow) from the right internal carotid artery. The vertebral artery originates from the posteromedial aspect of the right internal carotid artery.

OUTCOME AND FOLLOW-UP

The patient was evaluated by cardiology and confirmed to have apical akinesis and a cardiac ejection fraction of 35%, but with no intracardiac thrombus. She continued to require mechanical ventilation despite some improvement with appropriate motor function to commands on her right arm and leg.

DISCUSSION

Embryological cerebral perfusion patterns can persist into adulthood and can explain irregular distributions of common cerebrovascular disease. This patient had cervical internal carotid atherosclerosis without significant VA disease and presented with basilar artery occlusion stroke.

Successful thrombectomy requires access to the lesion. Patients with stroke frequently have comorbid longstanding hypertension and vasculopathy and therefore also have vascular tortuosity and

Figure 2 (A) Oblique sagittal CT angiogram (CTA) demonstrates the diminutive right V2 segment (arrows). (B) Oblique sagittal CTA demonstrates the robust right V3 segment passing through the hypoglossal canal (arrowhead) in close proximity to the distal cervical right internal carotid artery (ICA) (arrow).

Figure 3 (A) Lateral right internal carotid artery (ICA) catheter angiogram showing basilar occlusion distal to the origin of the anterior inferior cerebellar artery (arrow). (B) Lateral right ICA catheter angiogram after thrombectomy showing recanalized distal basilar artery, superior cerebellar artery, and posterior cerebellar artery. (C) Cervical lateral common carotid artery angiogram demonstrating atherosclerotic disease.

widened aortic arches. The most common approach in neuroendovascular treatment is transfemoral because of the relative safety compared with direct first or second order cervical branch access. However, difficult navigation can prevent successful thrombectomy, and cervical transarterial access has been applied in selected cases.⁶ Cross-sectional imaging, which was required in several of the positive randomized controlled trials, can demonstrate acute large vessel occlusion but can also aid in pre-intervention evaluation of the vascular tree. For example, diagnosis of a type II aortic arch or a bovine arch can expedite selective catheterization of the occluded vessel.⁶ In this case, close examination of the cross-sectional imaging demonstrated the atypical origin of the vertebrobasilar system and the required transcarotid access to the site of the occlusion. In a previous case report, diagnostic angiography of the vertebral arteries demonstrated hypoplastic vertebral arteries not amenable to endovascular access before evaluation of the carotid circulation demonstrated the accessible persistent trigeminal artery.⁵ Distal catheter and device access is particularly important with the current generation of thrombectomy techniques compared with historical arterial thrombolytic infusion techniques.⁷

Secondary stroke prevention is an ongoing challenge, whether or not endovascular thrombectomy is employed. Beyond basic medical optimization, the origin of the thromboembolic occlusion leads to further preventive measures; the most common etiologies include atrial fibrillation or valvular heart disease with cardioembolic origin, or carotid disease and intracranial atherosclerosis with vessel-to-vessel thromboembolism. Distinguishing cardiac versus vessel origin of the thromboembolism is important in guiding the application of anticoagulation versus dual antiplatelet therapy. Without evidence of proximal VA atherosclerosis, isolated basilar occlusion would be suspected to originate from a cardioembolic source, but the presence of a persistent carotico-basilar anastomosis introduces cervical carotid disease as a possible etiology. Some series of fetal-type posterior communicating arteries have demonstrated unusual simultaneous anterior and posterior circulation ischemia.^{8,9} Since the embryologic posterior communicating artery is persisting and presents the most distal carotico-basilar anastomosis, it is conceptually an extension of other less common persistent embryologic anatomies. Understanding the cerebral perfusion pattern can explain various stroke and embolization patterns.^{5,10-13}

Recognition of persistent embryologic perfusion patterns can highlight potential challenges to mechanical thrombectomy in acute ischemic stroke and subsequently guide secondary stroke prevention.

Learning points

- Persistent embryologic cerebrovascular supply can alter the classic pathophysiology of ischemic stroke.
- Recognition of anatomic variants prior to emergent endovascular intervention can expedite an otherwise technically difficult procedure.
- Recognition of anatomic variants such as carotico-vertebral anastomoses can impact the workup of ischemic stroke and secondary stroke prevention.

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