Primitive Hypoglossal Artery and Carotid Endarterectomy

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SUMMARY A patient with transient ischemic symptoms in the carotid and vertebrobasilar distribution is reported. His arteriogram demonstrated a persistent primitive hypoglossal artery which in part may explain the clinical picture. The embryology, radiology, clinical manifestations, and surgical considerations of this rare anomaly are discussed.

THE PRIMITIVE HYPOGLOSSAL artery exists 7 days as a temporary communication between the formative elements of the basilar artery and the internal carotid artery in the 4 mm human embryo. The persistence of a hypoglossal artery has been reported, primarily as an incidental and asymptomatic observation at the time of carotid angiography. Persistence of the hypoglossal artery in the patient presented in this report was believed to be a significant factor in the clinical presentation of his transient ischemic attacks.

A 61-year-old white male was admitted to St. Luke's Hospital of Kansas City for evaluation of cerebrovascular disease. He had symptoms suggestive of embolic carotid transient attacks manifested by episodes of numbness in the right upper and lower extremity, diplopia, dizziness, and dysequilibrium. These latter symptoms suggested vertebrobasilar transient ischemic attacks. He had had a coronary artery bypass operation 6 years earlier. The patient was normotensive with a bruit over the left carotid bifurcation and had a normal neurological examination.

An arch aortogram with bilateral selective biplane carotid evaluation was performed (fig. 1). A persistent hypoglossal artery was found arising from the left internal carotid artery and providing blood flow to the basilar artery and all its major branches except the posterior inferior cerebellar artery (figs. 2, 3). An atherosclerotic plaque with severe stenosis and ulceration was demonstrated just above the bulb of the left internal carotid artery and proximal to the origin of the hypoglossal artery. The right carotid arterial system was normal and both vertebral arteries, while hypoplastic, provided flow to the posterior inferior cerebellar arteries with no connection to the basilar artery.

The patient had a left carotid endarterectomy using continuous electroencephalographic monitoring. The left internal carotid mean arterial stump pressure at operation was 25 mm Hg and a temporary inlying shunt was used during carotid occlusion. The patient had no complications and was discharged on the third postoperative day.

Embryology

The embryologic development of the carotid and vertebrobasilar systems has been described by Padget based on his extensive dissections of the 4–5 mm human embryo. In the human embryo the carotid arteries arise from the third paired aortic arches. The
vertebral arteries result from longitudinal anastomoses of the first 6 cervical intersegmental arteries with regression of the origins of all the intersegmental arteries from the dorsal aorta except the sixth intersegmental artery which persists as the origin of the vertebral artery from the subclavian artery. The basilar artery forms from the fusion of the bilateral longitudinal neural arteries which develop in the hind brain region and are supplied caudally by the suboccipital intersegmental arteries which persist as the vertebral artery communication with the basilar artery. In the early phase of embryologic development the longitudinal neural arteries are also supplied cranially by 3 transitory primitive arteries: the trigeminal, the otic, and the hypoglossal. These 3 primitive arteries which arise from the internal carotid artery regress and disappear rapidly after the development of the posterior communicating arteries. Persistence of any one of these primitive arteries is a rarity and results in a major carotico-basilar communication. The normal life span of these primitive arteries is less than 7 days.

Radiology

Lie has defined 4 anatomical criteria in describing the persistence of the primitive hypoglossal artery, including: 1) the hypoglossal artery arises in the cervical region at the level of CI-CIII as a robust branch of the internal carotid artery; 2) After a somewhat tortuous course the hypoglossal artery proceeds through the anterior condyloid foramen (the hypoglossal canal) to the posterior cranial fossa (it does not pass through the foramen magnum); 3) The basilar artery is filled only beyond the point of junction with the
FIGURE 3. Anterior-posterior view of the selective left carotid injection demonstrates simultaneous filling of the internal carotid and basilar artery distribution.

anastomosis; 4) The posterior communicating arteries are absent (i.e. are not visible on the arteriogram). According to Lie the vertebral artery is either aplastic on the ipsilateral side and hypoplastic on the contralateral side or hypoplastic on both sides.

Comment

Persistence of the embryologic hypoglossal artery is a rare anomaly which is most likely to be seen as an asymptomatic and incidental arteriographic finding. This patient had transient neurologic symptoms of numbness in the right arm and leg, suggesting embolic episodes in the distribution of the left internal carotid artery and symptoms of diplopia, dizziness, and dyssequilibrium, suggesting transient ischemia in the verteobasilar system. Emboli from the stenotic ulcerated atherosclerotic plaque in the internal carotid artery proximal to the hypoglossal artery were believed to be the cause of symptoms coming from anterior and posterior intracranial circulation.

A clinical therapeutic distinction between carotid and vertebrobasilar symptoms is commonly made, and patients with vertebrobasilar symptoms often are treated with anticoagulants or antiplatelet drugs without angiographic evaluation. The persistence of the hypoglossal artery seen in this patient represents an exception, though rare, to the usual clinical localization of transient ischemic symptoms. Gilmartin\textsuperscript{a} reported a patient with an identical arteriographic picture and similar clinical symptoms who expired without treatment and was found at autopsy to have cerebral and cerebellar infarctions.

Carotid occlusion during endarterectomy in this patient had a potential effect on blood flow in the left internal carotid as well as the vertebrobasilar arterial system. The anterior communicating artery provided the only collateral flow to the left internal carotid system. Consequently, a temporary inlying shunt was used in this patient and the EEG was monitored continuously during carotid occlusion. The hypoglossal artery arises from the internal carotid artery between the first and third cervical vertebral bodies, and, consequently, the insertion of a shunt with this anomaly requires care to avoid trauma to this bifurcation while insuring proper placement for adequate perfusion of both the internal carotid and the hypoglossal artery.

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References

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