CASE REPORT

Bilateral persistent hypoglossal arteries: MRI findings

H TAKAHASHI, MD, H TANAKA, MD, N FUJITA, MD and N TOMIYAMA, MD, PhD

Department of Radiology, Osaka University Graduate School of Medicine, Osaka, Japan

ABSTRACT. Persistence of foetal anastomoses between carotid and vertebrobasilar arteries is well recognised, but their bilateral presence is rare. We report a case of bilateral persistent hypoglossal arteries. Absence of bilateral vertebral arteries was incidentally noted on neck ultrasound examination. Subsequent MRI confirmed this and revealed persistent hypoglossal arteries that arose bilaterally from the cervical internal carotid artery, entered the cranium through the hypoglossal canal and joined the lower portion of the basilar artery.

Received 13 July 2010
Revised 11 November 2010
Accepted 23 November 2010

DOI: 10.1259/bjr/21939976

© 2012 The British Institute of Radiology

Persistent hypoglossal artery is the second most common persistent carotid-basilar anastomosis (the most frequent is trigeminal artery) [1, 2]. Its incidence is reported to be 0.1–0.2% [3], which indicates that bilateral presence of persistent hypoglossal artery is extremely rare. To the best of our knowledge, there are only two reported cases of bilateral persistent hypoglossal arteries, both of which were found on conventional angiography [4, 5]. We report a case of incidentally identified bilateral persistent hypoglossal arteries with characteristic findings of this vascular anomaly on MRI [2, 6].

Case report

A 76-year-old female with hypertension underwent a routine check-up with neck ultrasound examination, which revealed a mild atherosclerotic change to the carotid arteries. The vertebral arteries were also inspected but not identified on either side. Steno-occlusive disease was suspected because of this finding and the patient was therefore referred for an MR examination of the supra-aortic vessels. Time-of-flight (TOF) MR angiography demonstrated that anomalous arteries arose from the cervical segment of the internal carotid artery at the C3 vertebral level on the right side and at the C1–2 level on the left side (Figure 1a). The vertebral arteries on both sides could not be identified from their origin. Subsequent MR examination of the brain was performed to evaluate the course of these anomalous arteries. TOF MR angiography revealed that the arteries entered the cranium and joined the basilar artery (Figure 1b, c). Constructive interference in steady state (CISS) confirmed that their course passed through the hypoglossal canal on both sides (Figure 1d). Vasculature was otherwise normal. No infarction or other abnormality was noted.

Discussion

During the early stage of embryological development, the carotid system and two parallel longitudinal neural arteries supply the forebrain and the hindbrain, respectively. The latter arteries run along the surface of the hindbrain and finally form the vertebrobasilar system. Four primitive anastomoses occur between the carotid and vertebrobasilar systems. The most distal is the trigeminal artery. More proximal anastomoses via the internal auditory canal (otic artery), hypoglossal canal (hypoglossal artery) and foramen magnum (proatlantal artery) are formed. A pair of longitudinal neural arteries is supplied by the carotid system via these anastomoses. Normally, these anastomoses remain functional for approximately 7–10 days during the early stage of foetal development and then obliterate at the rate at which the posterior communicating arteries and vertebral arteries develop [1]. The otic artery regresses first, followed by the hypoglossal artery, the trigeminal artery and the proatlantal artery successively regressing. Failure of this obliteration results in the persistence of embryonic arteries (Figure 1e), which, to a variable extent, leads to hypoplasia of the vertebrobasilar system.

When one of the two most proximal anastomoses, *i.e.* a hypoglossal artery or proatlantal artery, persists, the vertebral arteries are hypoplastic and the ipsilateral vertebral artery may be absent. In particular, if the anomaly is bilateral, the bilateral vertebral arteries are absent from their origin, as in our case of bilateral persistent hypoglossal arteries, as well as in the case of bilateral persistence of proatlantal arteries [7, 8]. In the same way as the proatlantal artery, the persistent hypoglossal artery arises from the extracranial internal carotid artery. Differentiation between these anastomoses on angiographic examination requires careful analysis because these primitive arteries take a similar course [9]. As shown in Figure 1d, it is easy to differentiate between these primitive arteries on MRI by demonstrating the foramen through which the artery passes [2, 6].

The persistent hypoglossal artery is commonly an incidental finding; however, it may be of clinical

Address correspondence to: Dr Hiroto Takahashi, Department of Radiology, Osaka University Graduate School of Medicine, 2-2 Yamadaoka Suita, Osaka 565-0871, Japan. E-mail: h-takahashi@radiol.med.osaka-u.ac.jp

Figure 1. (a) Right posterior oblique view of three-dimensional time-of-flight (3D-TOF) MR angiography in the supra-aortic region (repetition time (TR)/time to echo (TE) = 25/3.2, 20° flip angle) demonstrates anomalous arteries arising from cervical segment of the internal carotid artery at the C3 vertebral level on the right-side and the C1–2 level on the left (arrows). The bilateral vertebral arteries were absent from their origin. (b) Coronal and (c) axial reformatted views of 2 slab 3D-TOF MR angiography in the brain (TR/TE = 25/5.4, 15° flip angle). In the coronal view, the anomalous arteries (arrows) apparently followed the normal course of the vertebral artery and joined the lower portion of the basilar artery. In the axial view, the arteries arose from the cervical segment of the internal carotid artery (arrows) took an abnormal dorsal course and entered the cranium before joining the basilar artery. (d) Constructive interference in steady state image (TR/TE = 5.6/2.8, 37° flip angle) clearly shows that the anomalous arteries entered the cranium through the hypoglossal canal on both sides. (e) Persistent foetal carotid-vertebrobasilar anastomoses are shown. The trigeminal, otic and hypoglossal arteries run with the corresponding cranial nerves. The proatlantal artery runs most proximal. The hypoglossal and proatlantal arteries take similar courses. ICA, internal carotid artery; P-com, posterior communicating artery.

significance in some situations. Aneurysms occasionally develop at the junction of this artery with the basilar artery [10]. In the setting of carotid bifurcation disease, vertebral arterial steal may occur because of preferential flow from the vertebrobasilar system to the carotid artery via the persistent hypoglossal artery. Isolated posterior circulation infarcts, as well as combined anterior and posterior circulation disease manifestations, have been described with carotid bifurcation atherosclerosis and persistent hypoglossal artery [11]. The persistent hypoglossal artery may account for the unusual symptoms, particularly if the anomaly is bilateral.

In our case of bilateral persistent hypoglossal arteries, absence of bilateral vertebral arteries was noted on neck ultrasound examination. Variations in the normal anatomy of the extracranial vertebral artery are relatively frequent and range from asymmetry of both vertebral arteries to significant hypoplasia of one vertebral artery [12]. However, the absence of vertebral arteries on both sides is quite unusual and may indicate steno-occlusive disease or provide an important clue in the diagnosis of persistent foetal communications. For such cases, MRI is useful for further evaluation, as in our case of bilateral persistent hypoglossal artery, which showed MRI findings that were characteristic of this vascular anomaly.

References

1. Padgett DH. The development of the cranial arteries in the human embryo. *Cont Embryol* 1948;32:205–61.
2. Luh GY, Dean BL, Tomsick TA, Wallace RC. The persistent fetal carotid-vertebrobasilar anastomoses. *AJR Am J Roentgenol* 1999;172:1427–32.
3. Lie TA. Congenital anomalies of the carotid arteries. Amsterdam: Excerpta Medica Foundation, 1968.
4. Karasawa J, Kikuchi H, Furuse S. Bilateral persistent carotid-basilar anastomoses. *AJR Am J Roentgenol* 1976;127:1053–56.
5. Murayama K, Fujimoto N, Matsumoto K. Bilateral persistent primitive hypoglossal arteries associated with a large ruptured aneurysm on one side. *Surg Neurol* 1985;24:498–502.
6. Fujita N, Shimada N, Takimoto H, Satou T. MR Appearance of the persistent hypoglossal artery. *AJNR Am J Neuroradiol* 1995;16:990–92.
7. Woodcock RJ, Cloft HJ, Dion JE. Bilateral Type 1 proatlantal arteries with absence of vertebral arteries. *AJNR Am J Neuroradiol* 2001;22:418–20.
8. Gumus T, Onal B, Ilgit ET. Bilateral persistence of Type 1 proatlantal arteries: report of a case and review of the literature. *AJNR Am J Neuroradiol* 2004;25:1622–24.
9. Anderson RA, Sondheim FK. Rare carotid-vertebrobasilar anastomoses with notes on the differentiation between proatlantal and hypoglossal arteries. *Neuroradiology* 1976;11:113–8.
10. Kodama N, Ohara H, Suzuki J. Persistent hypoglossal artery associated with aneurysms: report of two cases. *J Neurosurg* 1976;45:449–51.
11. Conforto AB, de Souza M, Puglia P Jr, Yamamoto FI, da Costa Leite C, Scaff M. Bilateral occipital infarcts associated with carotid atherosclerosis and a persistent hypoglossal artery. *Clin Neurol Neurosurg* 2007;109:364–67.
12. Jeng JS, Yip PK. Evaluation of vertebral artery hypoplasia and asymmetry by color-coded duplex ultrasonography. *Ultrasound Med Biol* 2004;30:605–9.