



A Type 1 Persistent Proatlantal Artery Originating from the External Carotid Artery Detected by Computed Tomographic Angiography

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A persistent proatlantal artery (PA) is rare. We report a type 1 persistent PA originating from the right external carotid artery (ECA). A 78-year-old woman presented with dizziness. Computed tomographic (CT) angiography showed a persistent PA originating from the right ECA. This persistent PA did not pass through the atlas transverse foramen. The extracranial segment of this artery in the atlas transverse process level had a more lateral position than a normal left vertebral artery. CT angiography well demonstrated the relationship with bony structures and the course of this persistent PA. This anomalous artery in our patient presented as an incidental finding. Surgeon should recognize a persistent PA when performing carotid endarterectomy or ligation of the ECA for avoidance of complication.

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Keywords Persistent proatlantal artery, Clinical significance, Embryogenesis

INTRODUCTION

A persistent proatlantal artery (PA) is a well-recognized connection between the carotid and vertebral artery (VA). During embryogenesis, segmental arteries (the trigeminal artery, otic artery, hypoglossal artery, PA, and cervical intersegmental artery) interconnect the anterior cerebral circulation and posterior cerebral circulation.⁹⁾ The PA usually involutes by the 7- to 12-mm embryonic stage. Failure of involution and persistence of this PA contribute to persistent PA.⁷⁾ According to the origin and course of this anomalous artery, researchers divide this persistent PA into two types. Type 1 arteries arise from the internal carotid artery (ICA), external carotid artery (ECA), or common carotid artery (CCA) and ascend to the level of the suboccipital space without passing through the

transverse foramen of any cervical vertebra. Type 2 arteries originate from the ECA, join the VA between the atlas and axis, and pass through the transverse foramen of the atlas.¹⁾²⁾⁵⁾ Sometimes the readers had difficulty in identifying the relationship between bony structures and the persistent PA in case of persistent PA identified by conventional angiography or magnetic resonance angiography. We present a case of type 1 persistent PA diagnosed by computed tomographic (CT) angiography and discuss the anatomical characteristics and clinical significance of this anomalous artery.

CASE REPORT

A 78-year-old woman presented with dizziness that had developed 1 week earlier. Neurological examina-

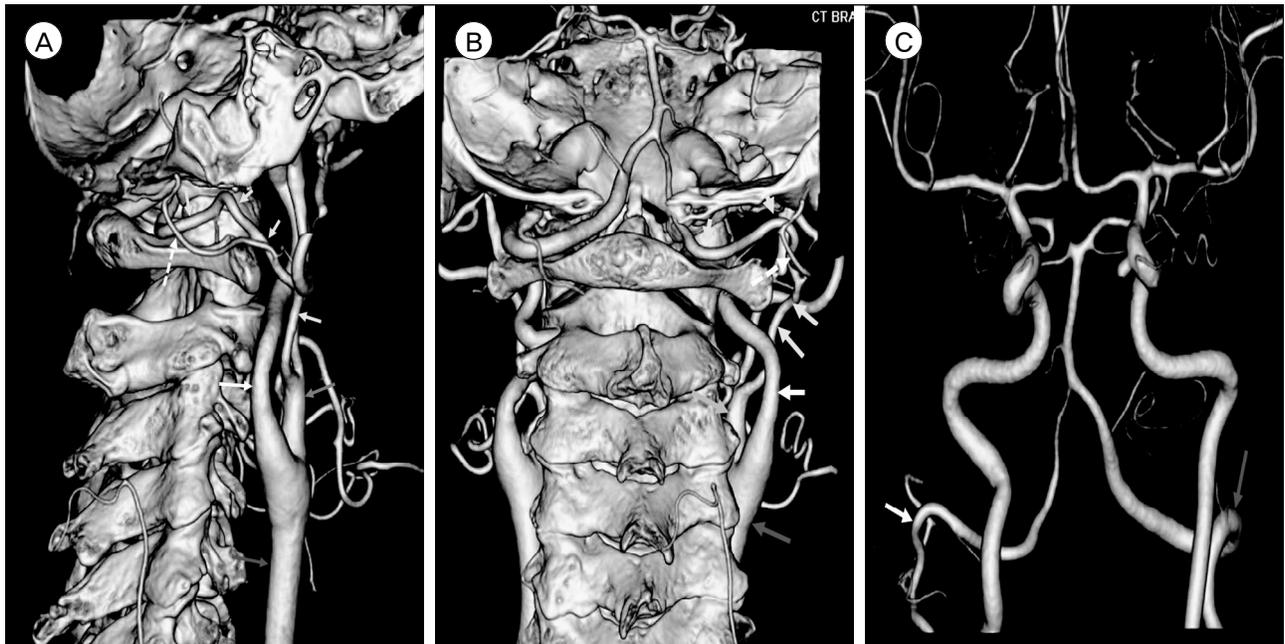


Fig. 1. Computed tomography (CT) angiography (A, B) demonstrates a right persistent proatlantal artery originating from the right external carotid artery. This anomalous artery courses between the occiput and atlas but does not pass through the atlas transverse foramen (white dotted arrow, occipital artery; yellow arrow, proatlantal artery; blue arrow, external carotid artery; red arrow, common carotid artery; white arrow, internal carotid artery). Reconstructed CT angiography (C) shows the more lateral location of the right vertebral artery extracranial segment (white arrow) compared with the normal left vertebral artery (red arrow).

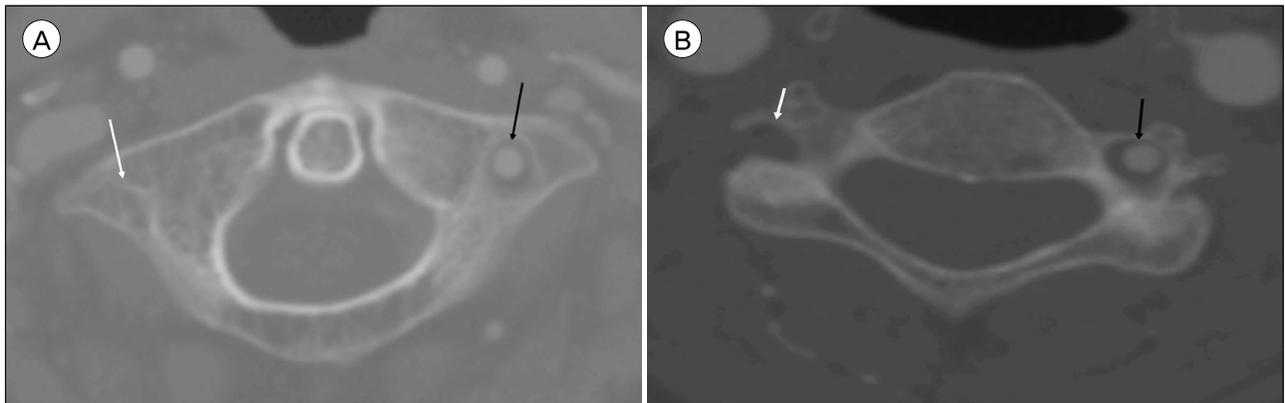


Fig. 2. Axial computed tomography images at the level of the first (A) and fourth (B) vertebral bodies show absence of a right vertebral artery in the right transverse foramen (white arrow) but an intact left vertebral artery in the left transverse foramen (black arrow).

tion showed neither nystagmus nor any abnormal neurological sign. She had a medical history of an appendectomy 30 years earlier, angina pectoris diagnosed 15 years earlier, and a left knee replacement operation one year earlier. She had taken medication for the angina pectoris. Brain CT demonstrated no abnormality. Brain CT angiography presented a 3

mm unruptured left superior hypophyseal artery aneurysm. CT angiography showed the absence of a proximal right VA, and a normal proximal left VA. The CT angiography also demonstrated an anomalous vessel arising from the right ECA at the level of the C2-3 intervertebral disc. This vessel extended superiorly and posteriorly and then made a curve

dorsally and above the atlas entering into the cranial cavity. It joined with the intracranial part of the VA after the passage through the foramen magnum (Fig. 1). The artery did not pass through the transverse foramen of the atlas (Fig. 2). The artery was considered to be a type 1 persistent PA originating from the ECA. The dizziness was improved after conservative treatment. The patient and her family refused trans-femoral cerebral angiography for diagnosis of the aneurysm.

DISCUSSION

The types of persistent PA

Two types of persistent PAs have been described, both arising from the carotid artery and connecting VA. A type 1 persistent PA arises from the ICA, ECA, or CCA and ascends to the level of the suboccipital space without passing through the transverse foramen of atlas. The artery takes a dorsal course at cephalad and lateral to the transverse process of the atlas and then meet extracranial VA and travels rostrally to enter the foramen magnum. A type 2 persistent PA (first cervical intersegmental artery) arises from the ECA and joins the VA between the atlas and axis. Because a type 2 persistent PA passes through the transverse foramen of the atlas, its dorsal curve is lower than that of type 1 persistent PA and more medial than type 1 persistent PA.¹⁾²⁾⁵⁾⁸⁾ The type 2 persistent PA is actually a persistent first cervical intersegmental artery. There are two important characteristics in definition of a persistent PA: one is a connection between the carotid and VA, and the other is its proatlantal course (i.e., between the occiput and atlas). According to these criteria, type 2 persistent PA is a misnomer. The correct terminology for a type 2 persistent PA is a persistent first cervical intersegmental artery. A persistent type 1 PA has three different potential origins (ICA, ECA, and CCA). The persistent PA in the present case is a type 1 PA originating from the ECA (Fig. 1). The right VA in the present case coursed more lat-

erally than a normal left VA because it did not pass through the atlas transverse foramen (Fig. 2). CT angiography clearly demonstrated the course of the persistent PA and its relationship with occiput, atlas, and axis.

When the persistent PA is large, the proximal VAs usually are hypoplastic, and the ipsilateral VA may be absent.²⁾³⁾¹⁰⁾ These findings are consistent with the CT angiographic finding (Fig. 1) in the present case. In condition of the absence of one or both VAs, clinician should consider the diagnosis of persistent PA between the carotid and VA.³⁾

Clinical significance

As in the present case, most persistent PAs are found incidentally. The clinical significance of a persistent PA is the possibility of developing atypical ischemic cerebrovascular disease.⁶⁾ When a persistent PA is present, carotid bifurcation stenosis may be responsible for symptoms in both anterior and posterior cerebral territories due to embolic infarction via persistent PA or hemodynamic infarction.⁴⁾ Clinicians should have suspicion a persistent PA in situation of simultaneous development of anterior and posterior cerebral infarctions. Existence of a persistent PA may modify surgical strategies in the context of carotid endarterectomy for carotid stenosis.³⁾ An anomalous type 1 persistent PA originating from the ICA associated with carotid bifurcation stenosis may be successfully treated by carotid endarterectomy applying two intraluminal balloon shunts (one shunt inserted from CCA to ICA and the other shunt inserted from CCA to persistent PA).⁴⁾ If stenosis in the right proximal ICA exists in our case, a second intraluminal shunt from the CCA to the persistent PA originating ECA may be difficult because of the high position of persistent PA origin. Therefore, we recommend carotid balloon angioplasty and stent insertion for carotid stenosis if the persistent PA has a high origin from the carotid bifurcation, especially in persistent PA with ECA origin.

CONCLUSION

Type 1 persistent PA originating from the ECA is a rare anomaly. CT angiography presented detailed anatomy of this anomalous artery and its relationship with bony structures. And CT angiography well diagnosed this anomalous artery. Clinicians should consider this persistent PA before performing carotid endarterectomy or ligation of the ECA.

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Disclosure

The authors report no conflict of interest concerning the materials and methods used in this study or the findings specified in this report.

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