

Proatlantal intersegmental artery and trigeminal artery associated with an aneurysm

Case report

YUICHIRO TANAKA, M.D., HIDEAKI HARA, M.D., GENKI MOMOSE, M.D.,
SHIGERU KOBAYASHI, M.D., SHIGEAKI KOBAYASHI, M.D., AND KENICHIRO SUGITA, M.D.

Department of Neurosurgery, Shinshu University School of Medicine, Matsumoto, and Kobayashi Neurosurgical Hospital, Ueda, Japan

✓ A case of coexisting proatlantal intersegmental artery and primitive trigeminal artery is described. These anomalies were incidental findings in a patient with hemiparesis due to occlusion of the middle cerebral artery. The primitive trigeminal artery had an asymptomatic aneurysm at its origin from the internal carotid artery.

KEY WORDS • proatlantal artery • trigeminal artery • aneurysm • occipital artery

THE trigeminal and proatlantal arteries supply the cranial and caudal portions of the brain stem, respectively, in the embryonic stage, where they play more important roles than the otic and hypoglossal arteries. These vascular channels usually regress by the time the embryo reaches a length of 14 mm.¹⁰ We report an adult case with coexisting proatlantal intersegmental and trigeminal arteries; the latter is further associated with an aneurysm. The role of the proatlantal intersegmental artery in relation to the development of the occipital artery is reviewed from the embryological standpoint.

Case Report

This 69-year-old woman was admitted to Kobayashi Neurosurgical Hospital on March 8, 1982. Two days before admission, she noted a sudden onset of weakness of the right extremities and speech disturbance. A computerized tomography scan showed a round low-density area in the left frontoparietal region. Neurological examination on admission revealed right hemiparesis of mild degree, including the face, with a positive extensor plantar reflex on the right side and motor aphasia.

Left carotid angiography demonstrated both the left carotid and posterior circulations (Fig. 1). A proatlantal intersegmental artery (PaA) arose from the posterior surface of the internal carotid artery at the upper border of the C-2 vertebral body, leading to the horizontal portion of the left vertebral artery without passing

through the foramen transversarium. Retrograde opacification reached the hypoplastic left vertebral artery through its horizontal portion. The left occipital artery was seen to arise from the top of the PaA. The bilateral posterior inferior cerebellar arteries were opacified via the respective vertebral arteries. The left posterior cerebral artery was demonstrated via the left posterior communicating artery, which was of medium size. Slow progress of contrast material into the several branches of the left middle cerebral artery because of incomplete occlusion was evident in the successive angiographic series. Left retrograde brachial angiography failed to demonstrate the left vertebral artery.

Right carotid angiography demonstrated a persistent trigeminal artery (TA) with an aneurysm arising at its junction with the internal carotid artery and projecting laterally. The contrast material flowed into the posterior circulation through the TA and hypoplastic posterior communicating artery, with good visualization of both the posterior cerebral and superior cerebellar arteries. A portion of the basilar artery caudal to the point of junction with the TA was hypoplastic (Fig. 2).

Right retrograde brachial angiography revealed a hypoplastic vertebral artery which took an ascending course in front of the vertebral bodies and entered the second foramen transversarium. The origin of the right vertebral artery was not defined by this angiogram (Fig. 3). Thus, the upper part of the posterior circulation was supplied by the right trigeminal artery and the

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lower part by the left proatlantal intersegmental artery (Fig. 4).

Discussion

Coexistence of multiple primitive arteries is a rare occurrence: We have found only four such cases in the literature. Oertel⁹ reported an autopsy case with right persistent trigeminal and right hypoglossal arteries. Karasawa, *et al.*,⁶ presented a case with left primitive otic and right primitive trigeminal arteries with multiple cerebrovascular malformations. Brea,³ and Binet and Young² each described patients with bilateral persistent trigeminal arteries. Our case demonstrates coexistence of the left proatlantal intersegmental and right trigeminal arteries. In addition, the patient had a trigeminal artery aneurysm. It is well known that patients with a persistent trigeminal artery frequently have an associated intracranial aneurysm, and this is seen in approximately 14% of cases. However, less than 1% of those cases have an aneurysm arising from the persistent trigeminal artery itself, as in our case.⁴

In 1885, Gottschau⁵ first described an adult in whom the proatlantal artery was found at autopsy, and the first angiographic description of this artery was given by Sutton.¹³ Rao and Sethi¹¹ presented a case of external carotid-vertebral anastomosis and proposed to call this anomaly a "proatlantal intersegmental artery" arising from the external carotid artery. Since then, the PaA has been divided into two subtypes, the external carotid type (Type E) and the internal carotid type (Type I).⁸ Our case is an example of Type I.

Lasjaunias, *et al.*,⁷ discussed the role of the PaA from the embryological viewpoint with special reference to the occipital artery. According to them, a primitive artery recognized as PaA in an adult is a rudimentary channel which should have become a proximal portion of the occipital artery. The proximal portion of the

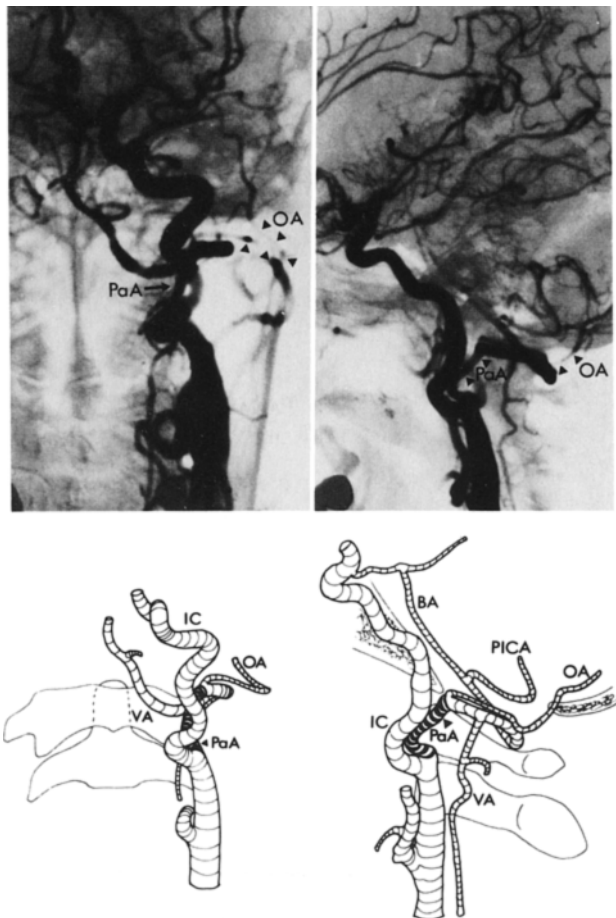


FIG. 1. Left carotid angiograms and explanatory diagrams, anteroposterior (*left*) and lateral (*right*) views, showing the proatlantal intersegmental artery (PaA) arising from the left internal carotid artery (IC). OA = occipital artery; VA = vertebral artery; BA = basilar artery; PICA = posterior inferior cerebellar artery.

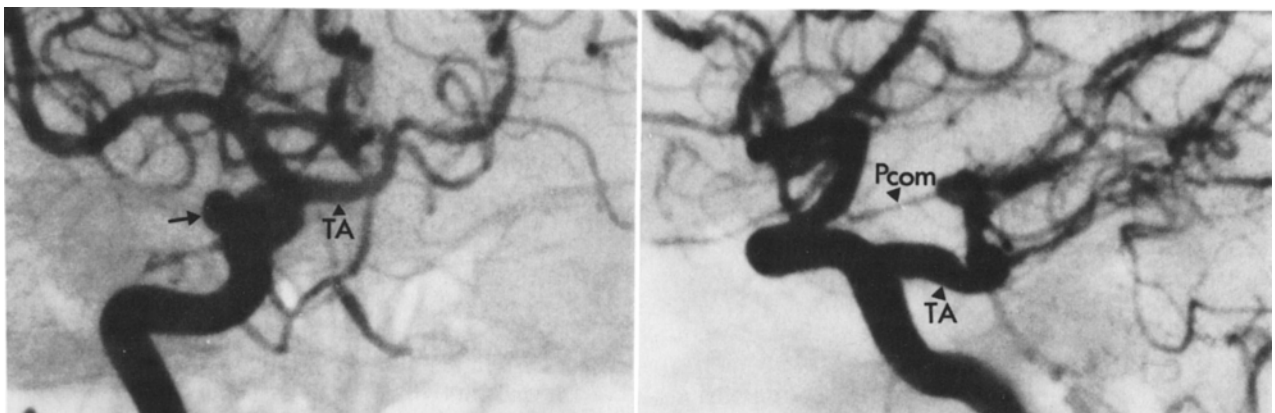


FIG. 2. Right carotid angiograms, anteroposterior (*left*) and lateral (*right*) views, showing the primitive trigeminal artery (TA) with an aneurysm. Pcom = posterior communicating artery. *Arrow* points to an aneurysm at the junction of trigeminal artery with internal carotid artery.

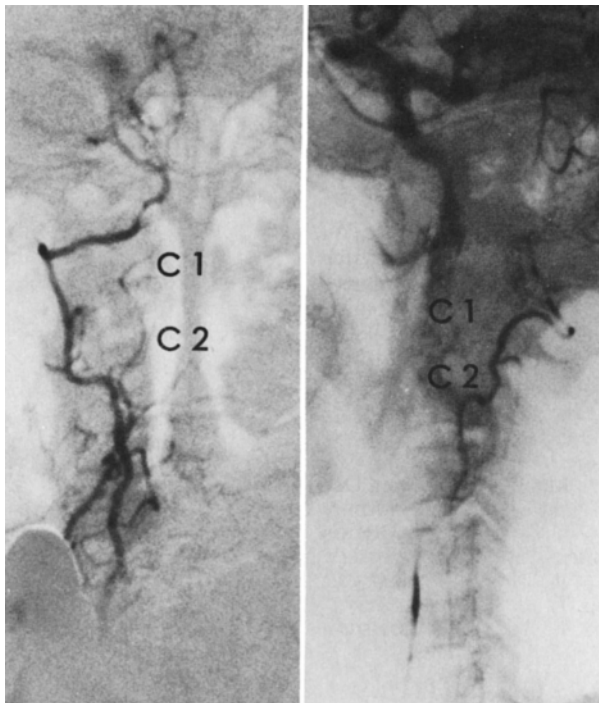


FIG. 3. Right retrograde brachial angiograms, anteroposterior (*left*) and lateral (*right*) views, showing the unusual course of the right vertebral artery and hypoplastic basilar artery. C1: atlas; C2: axis.

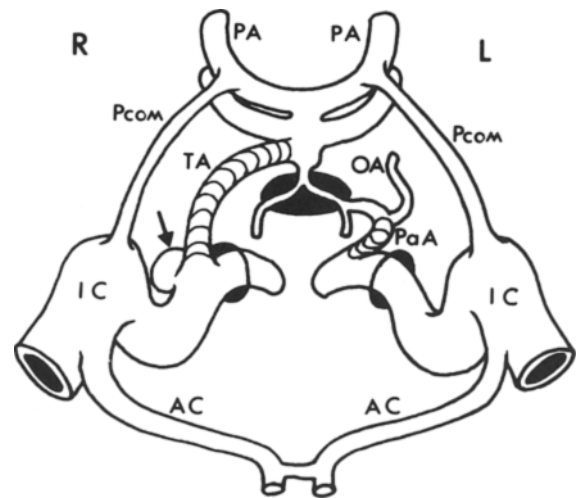


FIG. 4. Schematic drawing showing coexistence of the primitive arteries from the angiograms of our case. The trigeminal artery (TA) with an aneurysm (*arrow*) is on the right side and proatlantal intersegmental artery (PaA) on the left side. IC = internal carotid artery; AC = anterior cerebral artery; PA = posterior cerebral artery; Pcom = posterior communicating artery; OA = occipital artery.

occipital artery initially originates from the internal carotid artery and connects with the external carotid artery due to a transient intersegmental anastomotic channel. Three reported cases of PaA coexisting with an occipital artery^{1,8,12} are illustrated together with our case in Fig. 5. In the previous three cases the PaA arose

from the external carotid artery. In our case, unlike the other three cases where the vertebral artery was absent, the left hypoplastic vertebral artery had persisted, and the occipital artery arose from the proximal end of the horizontal portion of the vertebral artery. If the portion between the origin of the occipital artery and the terminal end of the cervical portion of vertebral artery had been absent, the occipital artery of internal carotid origin would have developed (Fig. 5d). Our case supports Lasjaunias' hypothesis as to the development of the PaA and occipital arteries.

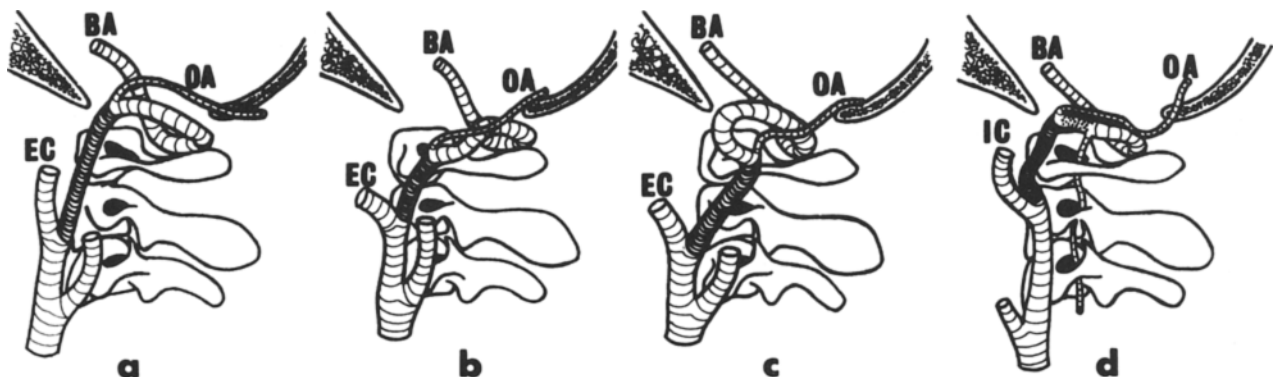


FIG. 5. Schematic representation of the proatlantal intersegmental artery with an occipital artery in three previously reported cases and in our case. a-c: Proatlantal intersegmental artery arising from the external carotid artery (EC); tracings of illustrations from the cases reported by a) Samra, *et al.*,¹² b) Anderson and Sondheimer,¹ and c) Obayashi and Furuse.⁸ d: Present case. BA = basilar artery; OA = occipital artery. *Dotted portion* indicates the anastomotic channel of the occipitoatlantal space.

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References

1. Anderson RA, Sondheimer FK: Rare carotid-vertebro-basilar anastomoses with notes on the differentiation between proatlantal and hypoglossal arteries. *Neuroradiology* **11**:113-118, 1976
2. Binet EF, Young RF: Bilateral persistent trigeminal arteries. Case report. *J Neurosurg* **47**:619-622, 1977
3. Brea GB: Sulla persistenza della anastomosi carotido basilare. *Sistema Nervosa* **8**:17-23, 1956
4. George AE, Lin JP, Morantz RA: Intracranial aneurysm on a persistent primitive trigeminal artery. Case report. *J Neurosurg* **35**:601-604, 1971
5. Gottschau M: Zwei seltene Varietäten der Stämme des Aortenbogens. *Arch Anat Entwicklgesch*, 245-252, 1885
6. Karasawa J, Terano M, Nishikawa M, et al: [A case of persistent bilateral carotid-basilar anastomoses (primitive otic artery and primitive trigeminal artery) with multiple cerebrovascular anomalies.] *No To Shinkei* **24**:91-98, 1972 (Jpn)
7. Lasjaunias P, Théron J, Moret J: The occipital artery. Anatomy — normal arteriographic aspects — embryological significance. *Neuroradiology* **15**:31-37, 1978
8. Obayashi T, Furuse M: The proatlantal intersegmental artery. A case report and review of the literature. *Arch Neurol* **37**:387-389, 1980
9. Oertel O: Über die persistenz embryonaler Verbindungen zwischen der A. carotis interna und der A. vertebralis cerebialis. *Dtsch Med Wochenschr* **48**:1264, 1922
10. Padget DH: Designation of the embryonic intersegmental arteries in reference to the vertebral artery and subclavian stem. *Anat Rec* **119**:349-356, 1954
11. Rao TS, Sethi PK: Persistent proatlantal artery with carotid-vertebral anastomosis. Case report. *J Neurosurg* **43**:499-501, 1975
12. Samra K, Scoville WB, Yaghmai M: Anastomosis of carotid and basilar arteries. Persistent primitive trigeminal artery and hypoglossal artery: report of two cases. *J Neurosurg* **30**:622-625, 1969
13. Sutton D: Anomalous carotid-basilar anastomosis. *Br J Radiol* **23**:617-619, 1950

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Address for Drs. Momose and Shigeru Kobayashi: Kobayashi Neurosurgical Hospital, Ueda, Japan.

Address reprint requests to: Yuichiro Tanaka, M.D., Department of Neurosurgery, Shinshu University School of Medicine, Asahi 3-1-1, Matsumoto 390, Japan.