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Case Report

# Posterior Inferior Cerebellar Artery Originating from the Jugular Branch of the Ascending Pharyngeal Artery

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The variation in which the posterior inferior cerebellar artery arises from the hypoglossal branch of the ascending pharyngeal artery is thought to be related to the remnant of the primitive hypoglossal artery, and is referred to as a primitive hypoglossal artery variant. Cases in which the posterior inferior cerebellar artery arises from the jugular branch of the ascending pharyngeal artery are extremely rare. The authors present a case of a 50-year-old male with vertebral artery dissection who had this extremely rare variation bilaterally. The patient also had several rare variations of the intracranial vessels. This posterior inferior cerebellar artery arising from the jugular branch of the ascending pharyngeal artery may have developed due to the anastomosis between the meningeal and the pial vessels of the posterior fossa. Alternatively, an unknown primitive anastomotic artery may have passed through the jugular foramen. Genetic factors may play an important role in the presence of this anomalous vessel.

**Keywords:** ascending pharyngeal artery, carotid-vertebrobasilar anastomoses, jugular branch, persistent primitive artery, posterior inferior cerebellar artery

## Introduction

The posterior inferior cerebellar artery (PICA) usually arises from the intracranial portion of the vertebral artery. However, the PICA has numerous variations, and can emerge from the extracranial portion of the vertebral artery,[1)] internal carotid artery,[2)] primitive trigeminal artery,[3)] primitive hypoglossal artery,[4)] or posterior meningeal artery.[5)] The authors report an extremely rare variation in which the PICA arose from the jugular branch of the ascending pharyngeal artery (APA). This anomaly was found bilaterally in a case of vertebral artery dissection. Herein, the authors discuss the embryological background of the anomaly.

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## Case Report

A 50-year-old male had been experiencing nuchal pain for 1 week. Neurological examination revealed no abnormalities. MR imaging showed a stenosis of the right vertebral artery with an intramural hematoma (Fig. 1A). Basiparallel anatomic scanning revealed widening of the outer diameter of the right vertebral artery (Fig. 1B), leading to the diagnosis of vertebral artery dissection. In three-dimensional computed tomographic angiography, origin of the right PICA was barely recognizable, as it emerged from the dissected portion of the vertebral artery. However, its hemispheric branch was perfused by some other artery coming from the jugular foramen. These two arteries supplying the right cerebellar hemisphere might be connected in their periphery, but it could not be clarified on the image. As for the left PICA, it did not branch from the left vertebral artery, but entirely came from the left jugular foramen (Fig. 2A). In the cervical portion, the right APA branched from the external carotid artery, while the left APA emerged from the bifurcation of the internal and external carotid arteries (Fig. 2B). Digital subtraction angiography revealed that the hemispheric branch of the PICA on the right side originated from the jugular branch of the APA (Fig. 3A). The original PICA from the right VA was supplying only the medial half of the right cerebellar hemisphere (Fig. 3B). On the contralateral side, the PICA did not branch from the vertebral artery, but was perfused only by the jugular branch of the APA (Fig. 3C). Under the diagnosis of right vertebral artery dissection involving the PICA, lowering of the blood pressure without any surgical intervention was planned, as the PICA was considered to have sufficient collaterals. After 6 months, the inner and outer configurations of the dissected site were fully restored without any adverse event. In this patient, the transverse sinus was hypoplastic on the right side and aplastic on the left side, and the occipital and marginal sinuses were substantially enlarged in compensation (Figs. 4A and 4B). The patient also had a rare variation of the anterior cerebral artery, which had an infraoptic course bilaterally (Figs. 4C and 4D).

Written informed consent was obtained from the patient for publication of this case report.

## Discussion

The variation in which the PICA arises from the hypoglossal branch of the APA is thought to be related to the

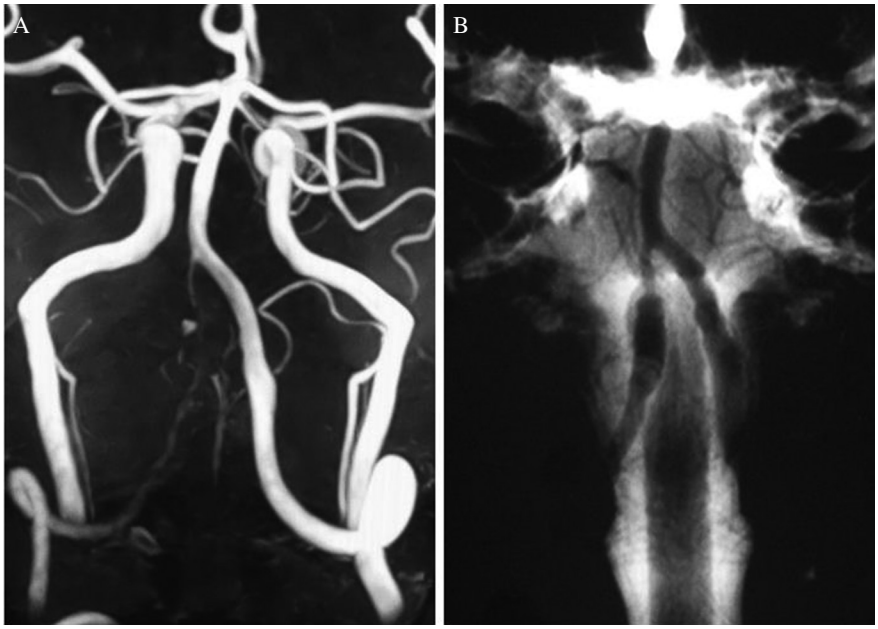


**Fig. 1** Magnetic resonance angiography performed at admission. (A) Stenosis of the lumen of the right vertebral artery was observed. (B) Basiparallel anatomical scanning performed at admission. The outer diameter of the artery was expanded.

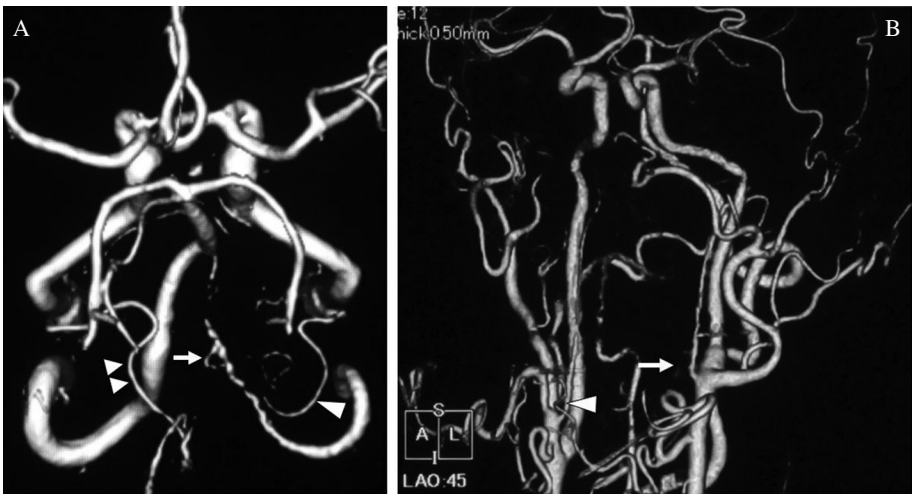


**Fig. 2** Three-dimensional computed tomographic angiography. (A) The right posterior inferior cerebellar artery (PICA) branched from the dissected portion of the right vertebral artery (arrow). The hemispheric branch of the PICA was perfused by some other artery coming from the jugular foramen (arrowhead). As for the left PICA, it entirely came from the left jugular foramen (double arrowhead) instead of branching from the vertebral artery. (B) In the cervical portion, the right ascending pharyngeal artery (APA) branched from the external carotid artery (arrowhead), and the left APA branched from the inside of the bifurcation (arrow).

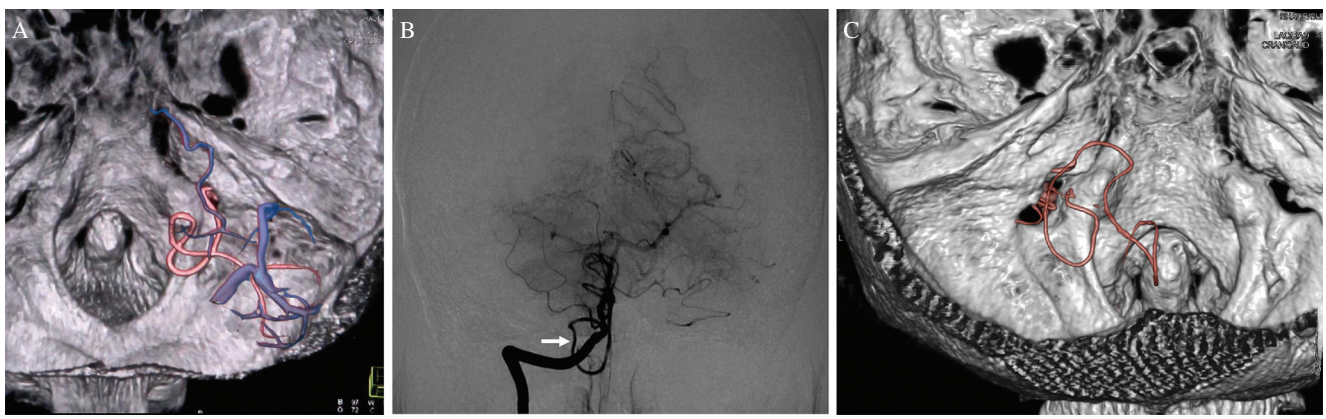


**Fig. 3** Digital subtraction angiography. (A) Selective angiography of the right ascending pharyngeal artery (APA). The hemispheric branch of the right posterior inferior cerebellar artery (PICA) was perfused by the jugular branch of the APA. The artery is colored red, while the vein is colored blue. (B) Right vertebral angiography. The original PICA from the right vertebral artery (arrow) was supplying only the medial half of the right cerebellar hemisphere. (C) Selective angiography of the left APA. The cortical and medullary segments of the left PICA were perfused by the jugular branch of the APA.

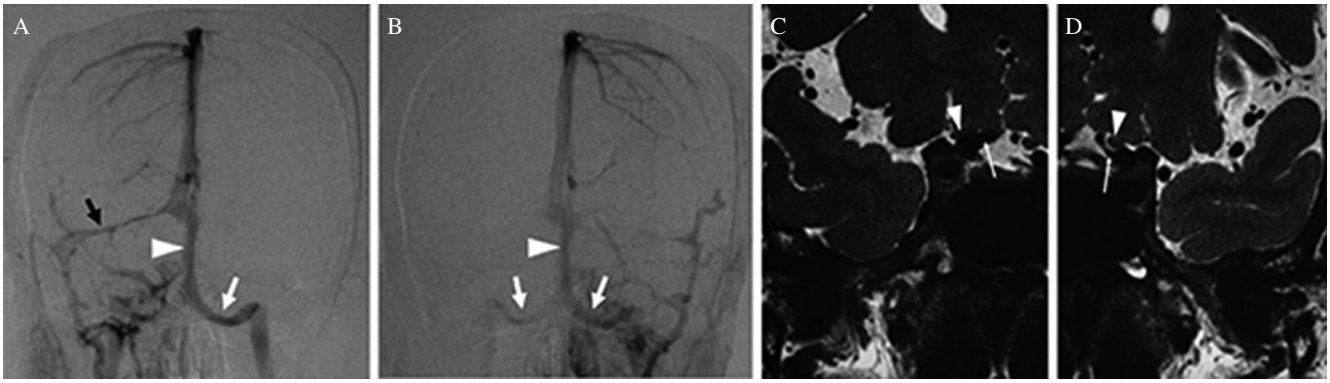


**Fig. 4** Other anatomical anomalies seen in the patient. (A and B) Angiography of the right (A) and left (B) internal carotid arteries. The right transverse sinus (black arrow) was hypoplastic, while the transverse sinus was absent on the left side. The occipital sinus (white arrowhead) and bilateral marginal sinuses (white arrow) were highly developed. (C and D) Coronal sections of T2-weighted MR images. The A1 segments of the anterior cerebral artery (arrows) on both sides (A: right, B: left) were running under the optic nerves (arrowheads).

remnant of the primitive hypoglossal artery, and is referred to as a primitive hypoglossal artery variant.[6,7] The variation in which the PICA originates from the jugular branch of the APA, as seen in the present case, has only been reported in three previous cases in the literature.[8,9] This variation seems to have a different embryological background to the primitive hypoglossal artery variant, as the vessel does not pass through the hypoglossal canal. Uchino et al.[8] suggested that this variant vessel was established due to the complementation between the meningeal vessels arising from the APA and those of the vertebral artery, and because anastomosis can develop between the meningeal vessels and the PICA as a pial vessel.

There are two previous reports of another variation, an innominate artery that arises from the carotid artery system and passes through the jugular foramen to connect to the basilar artery.[10,11] This variation seems to have a similar embryological background to the present case. Ryu et al.[11] suggested that there might be an unknown primitive anastomotic artery (referred to as the primitive glossopharyngeal artery) that passes through the jugular foramen.

Regarding the development of the cranial arteries in the human embryo, the study by Padget[12] is of great renown. Padget[12] examined 22 embryos that ranged in size from 3 to 43 mm. According to her observation of two stage I embryos (4–5 mm in size) and two stage II embryos (5–6 mm), three primitive anastomotic vessels could be identified in stage I: the primitive trigeminal artery, the primitive otic artery, and the primitive hypoglossal artery. In stage II, however, most of these arteries had regressed, showing the marked changes in the vascular architecture in these stages. The trigeminal artery corresponds to cranial nerve V, the otic artery to cranial nerves VII and VIII, and the hypoglossal artery to cranial nerve XII. In contrast, there is no corresponding artery to cranial nerves IX, X, and XI. Among the cranial nerves of the posterior fossa, the cranial nerves IX, X, and XI thus seem quite specific. As Ryu et al.[11] speculated, there might exist an unknown primitive anastomotic vessel corresponding to these nerves of the jugular foramen, which could not be found in the 22 embryos examined by Padget. This vessel might have already diminished before stage I.

The present patient had this type of variation in which the PICA originates from the jugular branch of the APA bilaterally, as well as several other anatomical anomalies. Among them, the infraoptic course of the anterior cerebral artery is known to be associated with various anomalies of the cerebral arteries.[13] Genetic factors may play an important role in the presence of these anomalous vessels. It may be speculated that the primitive vessel might persist in subjects with a certain gene.

## Conflicts of Interest Disclosure

All authors have no conflict of interest. They have registered online Self-reported COI Disclosure Statement Forms through the website for JNS members.

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