



# Anomalous anastomosis between the external carotid artery and vertebrobasilar artery via the hypoglossal canal: a case report and review of literature

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## Abstract

We report a case of an anomalous anastomosis formed between the external carotid artery (ECA) and the vertebrobasilar artery (VBA) and passing through the hypoglossal canal. A carotid–vertebrobasilar anastomosis of this kind is typically considered a variant of persistent primitive hypoglossal artery which usually originates from the internal carotid artery. However, the anastomotic vessel in this case had a common trunk with the occipital artery (OA), a remnant of the primitive proatlantal artery. The proximal and distal parts of the anastomotic vessel seemed to have been derived from the primitive proatlantal artery and the primitive hypoglossal artery, respectively. Thus, we propose that this ECA–VBA anastomosis, which passed through the hypoglossal canal and had a common trunk with the OA, be referred to as a dilated primitive hypoglossal–proatlantal anastomosis; that is, a dilated ascending pharyngeal artery rather than a variant of persistent primitive hypoglossal artery.

**Keywords** Primitive hypoglossal artery · Proatlantal artery · External carotid artery · Occipital artery · Hypoglossal branch of ascending pharyngeal artery

## Introduction

The persistent primitive hypoglossal artery is an anomalous anastomosis between the internal carotid artery (ICA) and the vertebrobasilar artery (VBA) that passes through the hypoglossal canal. Its reported incidence is 0.027–0.26% [1]. Anastomosis between the external carotid artery (ECA) and VBA is rarer and, to our knowledge, only nine cases have been reported [5–8, 10, 11, 13]. Here, we present a case

of an ECA–VBA anastomosis, review previously reported cases, and discuss the appropriate nomenclature.

## Case report

A 59-year-old woman was admitted to our hospital with acute infarction of the right superior cerebellar artery territory. The conventional angiography revealed an anomalous vessel originating from the right ECA at the C3–4 level and terminating at the V4 segment of the right vertebral artery at the origin of the posterior inferior cerebellar artery (Fig. 1a). The right occipital artery (OA) originated from this anomalous artery at the C1–2 level and passed transversely between the C1 and C2 vertebral bodies (Fig. 1b). The right vertebral artery is not visible on the angiography of the right brachiocephalic artery. The left vertebral artery almost terminated at the posterior inferior cerebellar artery, suggesting that the distal part of the left vertebral artery may have been hypoplastic. The posterior cerebral arteries were bilaterally supplied by the respective ipsilateral anterior circulations through the posterior communicating arteries (fetal type) (Fig. 1a). Magnetic resonance angiographic

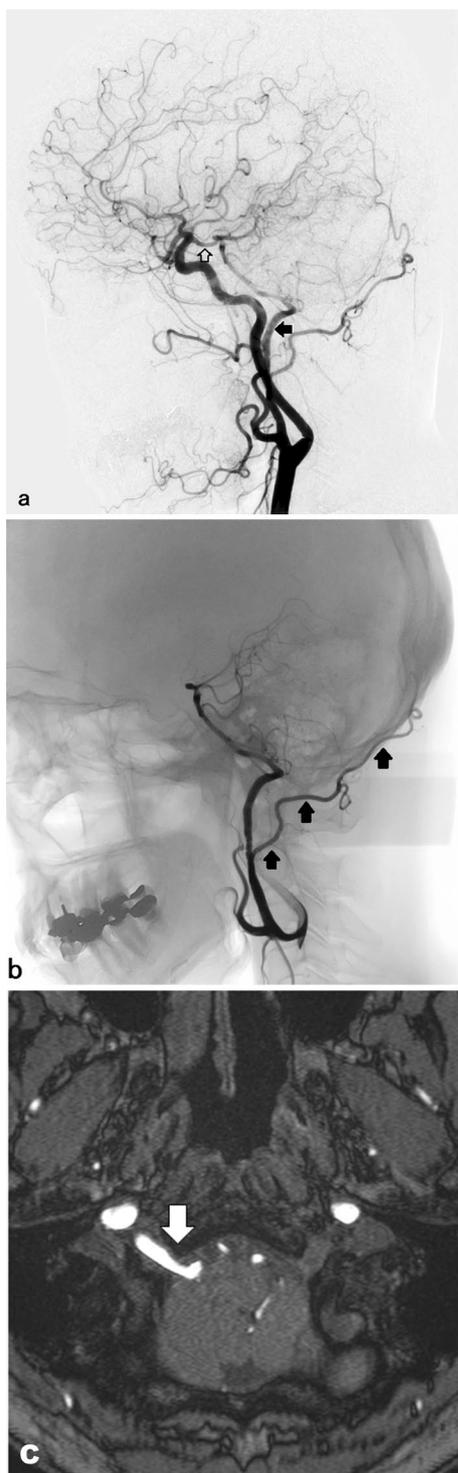
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**Fig. 1** Neuroradiologic findings. **a** Lateral angiographic projection of the right common carotid artery showing an anomalous vessel originating from the external carotid artery (ECA) and terminating at the vertebrasilar artery (black arrow). The posterior communicating artery is clearly visible (white arrow). **b** Lateral angiographic projection of the right ECA showing the occipital artery originating from the anomalous vessel (arrows). **c** Magnetic resonance angiographic source image showing that the anomalous anastomotic vessel passes through the right hypoglossal canal (arrow)

source image revealed that the anomalous anastomotic vessel traversed the right hypoglossal canal (Fig. 1c).

## Discussion

The primitive hypoglossal artery is one of the embryonic anastomoses between the carotid and vertebrasilar circulations. The embryonic anastomotic vessels typically disappear immediately after the development of the posterior communicating artery. Occasionally, these fetal anastomoses persist into adulthood. The persistent primitive hypoglossal artery is the second most frequently encountered remnant of such fetal anastomoses in clinical practice after the persistent primitive trigeminal artery [6]. The diagnostic criteria for persistent primitive hypoglossal artery proposed by Brismar are as follows: (1) the artery should leave the ICA as an extracranial branch, and (2) the artery should pass through the hypoglossal canal before anastomosing with the VBA [1].

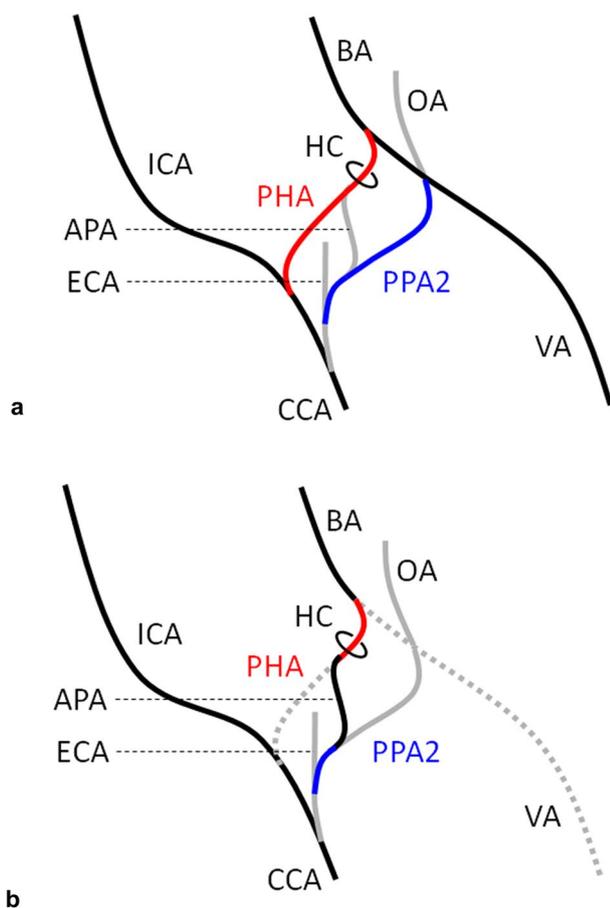
As far as we know, there are heretofore only nine reported cases of ECA–VBA anastomosis of the type seen in our patient [5–8, 10, 11, 13] (Table 1). In these cases, the ECA–VBA anastomosis was reported as a rare variant of persistent primitive hypoglossal artery, even though the aforementioned criteria were not met [1]. However, in our patient, the ECA–VBA anastomotic vessel had a common trunk with the right OA. The OA, which usually originates from the ECA and passes transversely between the C1 and C2 vertebral bodies [4], is thought to be a remnant of the primitive proatlantal artery [9]. Thus, in our patient, the proximal part of the anastomotic vessel (the part that shared a common trunk with the OA) was likely derived from the primitive proatlantal artery (more precisely, the primitive proatlantal artery type 2), and its distal part derived from the primitive hypoglossal artery as it passed through the hypoglossal canal. Of the nine previously reported cases of ECA–VBA anastomosis, a common trunk with the OA was visible in at least two instances. We posit that the anastomotic vessel represents a dilated primitive hypoglossal–proatlantal anastomosis.

A remnant of such primitive hypoglossal–proatlantal anastomosis persists into adulthood, though the anastomotic vessel is usually very thin. The ECA connected to the OA, relevant to the primitive proatlantal artery [9], branches the ascending pharyngeal artery. The hypoglossal branch of the ascending pharyngeal artery, passing into the skull through the hypoglossal canal, is thought to be a remnant of the primitive hypoglossal artery [6]. Thus, the ascending pharyngeal artery is an anastomotic vessel connecting the primitive hypoglossal and proatlantal arteries. Therefore, the ECA–VBA anastomosis via the hypoglossal canal, observed also in our case, is more appropriately termed dilated

**Table 1** Summary of reported cases of ECA–VBA anastomosis via hypoglossal canal

Authors	Age/sex	Side	Ipsilateral OA	Ipsilateral VA	Diagnostic modality
Welten et al. [13]	68/male	Left	Unknown	Absent	Angiography
Nakamura et al. [7]	59/male	Left	Common trunk with PHA	Hypoplastic	Angiography
Meguro et al. [6]	60/male	Left	Unknown	Hypoplastic	Angiography
Lee et al. [5]	78/male	Left	Unknown	Hypoplastic	MRA
Nanto et al. [8]	63/male	Right	Unknown	Hypoplastic	Angiography
Sabouri et al. [10]	70/male	Right	Common trunk with PHA	Hypoplastic	CTA
Uchino et al. [11]	75/male	Right	Unknown	Absent	MRA
	60/male	Right	Unknown	Absent	MRA
	59/female	Right	Unknown	Absent	MRA
Presented case	59/female	Right	Common trunk with PHA	Absent	Angiography

ECA external carotid artery, VBA vertebrobasilar artery, OA occipital artery, VA vertebral artery, PHA primitive hypoglossal artery, MRA magnetic resonance angiography, CTA computed tomographic angiography



**Fig. 2** Schematic diagram of vessels. Vascular changes from the embryonic stage (a) to the adult stage (b). APA ascending pharyngeal artery, BA basilar artery, CCA common carotid artery, ECA external carotid artery, ICA internal carotid artery, HC hypoglossal canal, OA occipital artery, PHA primitive hypoglossal artery, PPA2 primitive proatlantal artery type 2, VA vertebral artery

ascending pharyngeal artery, especially when the anastomotic artery has a common trunk with the OA (Fig. 2). This proposal is also supported by Uchino et al. [12]. Lasjaunias described this variation as the ascending pharyngeal artery (hypoglossal)–basilar anastomosis (type D) [2, 3].

In conclusion, while the ICA–VBA anastomosis which passes through the hypoglossal canal is named persistent primitive hypoglossal artery, the ECA–VBA anastomosis passing through the hypoglossal canal is more aptly termed dilated primitive hypoglossal–proatlantal anastomosis, that is, dilated ascending pharyngeal artery.

**Author contributions** RY: manuscript writing and case analysis. NM: case analysis. YN: case analysis. FT: manuscript editing. KJ: manuscript editing and case analysis.

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### Compliance with ethical standards

**Conflict of interest** The authors have no conflicts of interest to disclose.

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