Persistent trigeminal artery feeding a hemispheric branch of the posterior inferior cerebellar artery: A rare anatomic variant

Une artère trigéminée persistante se terminant en une branche hémisphérique de l’artère cérébelleuse postéro-inférieure : une variation anatomique rare

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Summary Persistent trigeminal artery is a rare persistent carotid-basilar anastomosis that usually connect the infracavernous segment of the ICA with the basilar artery. Rarely, PTA may feed cerebellar artery. We describe an exceptional case of PTA terminating in postero-inferior cerebellar artery (PICA) hemispheric branch. Angiographic and CTA features are presented and hypotheses regarding developmental origin of this variation are discussed.

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Introduction

Persistent trigeminal artery (PTA) is the most frequent persistent carotid-basilar fetal anastomosis, with a reported incidence of 0.1—0.6% in angiographic series [1]. Rare cases of PTA terminating in cerebellar artery have been described. We report an exceptional case of PTA directly supplying a hemispheric branch of the postero-inferior cerebellar artery (PICA) and present the first CT-angiography (CTA) description of the course of this rare vascular variant.

Case report

A 52-year-old woman was attended in our department for a preoperative endovascular embolization of a parasagittal
meningioma. Pre-embolization digital subtraction angiography (DSA) showed a left parasagittal tumor blush supplied by dural branches from the left middle meningeal artery and pial branches from both anterior cerebral arteries. Incidentally, a PTA was depicted arising from the Fisher C5 segment of the ICA. This PTA was supplying a PICA hemispheric branch that fed the inferolateral part of the left cerebellum hemisphere (Fig. 1A–C). Selective angiogram of left vertebral

Figure 1  A and B. Left internal carotid artery (ICA) digital subtraction angiography (DSA); lateral projections, arterial (A) and capillary (B) phases. C. Left ICA DSA: anteroposterior (AP) projection, arterial phase. D. Left vertebral artery DSA; lateral view, capillary phase. Persistent trigeminal artery (PTA) originating from the precavernous segment of ICA is seen (A, black arrow). The loop following the proximal segment of the PTA is seen on both lateral (A, double white arrows) and AP (C, arrow head) views. Posterolateral course of the PTA toward the posterior fossa is also demonstrated on DSA (A, arrow heads; C, white arrows). On capillary phase, hemispheric cerebellar territory fed by the PTA is seen (B, arrows). The rest of the PICA territory is supplied by the ipsilateral PICA originating from V4 segment of the vertebral artery (D, arrows). Note the tumor blush supplied by pial branches of the ACA (A and B, star), corresponding to the parasagittal meningioma.
artery showed a PICA arising from V4 segment, feeding the PICA territory except the inferolateral part of the left cerebellum hemisphere (Fig. 1D). CTA (Sensation 16, Siemens, Erlangen, Germany) performed few days latter, confirmed the medial origin of the PTA on the Fisher C5 segment of the left ICA and showed a lateroclival course. Then, the artery presented a posterolateral orientation along the trigeminal nerve and a superior convexity loop. Finally, the CTA demonstrated the course of the PTA along the petrous bone, above then behind the facial and acoustic nerves, toward the posterior fossa (Fig. 2).

**Discussion**

According to the human embryological vasculature development described by Padget, in 1948 [2], the two longitudinal neural arteries (LNA) are supplied by four temporary anastomoses between the posterior vascular plexus and the anterior carotid artery during early fetal life (approximately 35 days of gestational age): the trigeminal, otic, hypoglossal and proatlantal arteries. These anastomoses persist during about 1 week and disappear with the development of the posterior communicating artery and fusion of the paired LNA into the basilar artery. Occasionally, they may persist in adulthood. PTA is the most common carotid-basilar anastomosis, representing 85% of these primitive persistent anastomoses [1]. Usually, it originates from the ICA after its exit from the carotid canal and joins the upper third of basilar artery. Lateral or medial courses of PTA have been described. In the lateral type, the course of the artery is posterolateral, along the trigeminal nerve. On the contrary, the medial type has an intrasellar or transhypophyseal course.

Saltzman divided PTA variants in three types in 1959 [3]:

- type 1 carotidobasilar anastomosis at a level between superior cerebellar artery (SCA) and antero-inferior cerebellar artery (AICA), with a hypoplastic homolateral posterior communicating artery (Pcom);
- type 2: carotidobasilar anastomosis at the level of AICA with a patent homolateral Pcom;
- type 3: combination of types 1 and 2.

Cerebellar arteries that arise from the precavernous ICA and are not connected to the basilar artery are considered as variants of PTA [4]. Some authors have included these PTA variants in Saltzman type 3.

In 2008, Ali et al. [4] reviewed Saltzman classification and subdivided the third type in:

- type 3a: PTA terminating directly in the SCA;
- type 3b: PTA supplying the AICA;
- type 3c: PTA feeding the PICA.

The reported incidence of PTA variants is approximately 0.18% on DSA and 0.76% on MR angiography [5]. The most frequent artery fed by PTA is the AICA [5]. Less than 15 cases of type 3c PTA terminating in PICA have been described in the literature [6]. To our knowledge, only one case of PTA variant supplying directly a hemispheric branch of the PICA has been previously reported [4].

We based our hypothesis to explain the embryological origin of this variant on Lasjaunias et al. [7] theory about cerebral vasculature development. According to this theory, lateral longitudinal neural arteries (LLNAs) are formed by multiple anastomoses between intersegmental arteries, from the future posterior cerebral artery to the medullary level. From LLNAs originate branches for cerebellar arteries. As shown on Fig. 3, the non-regression of PTA and the partial non-regression of LLNA may explain this PTA variant. At the same time, hypoplasia of V4 segment may explain the
Figure 3  Drawing of the hypothesized embryological development of the PICA originating from a PTA (adapted from Lasjaunias and Berenstein [7]). A. Drawing of the primitive vasculature in the embryo. PCA: posterior cerebral artery; Pcom: posterior communicating artery; PTA: persistent trigeminal artery; O: otic artery; H: hypoglossal artery; POA: proatlantal artery; LNA: longitudinal neural artery; SCA: superior cerebellar artery; AICA: antero-inferior cerebellar artery; PICA: postero-inferior cerebellar artery; LLNA: lateral longitudinal neural anastomosis; ASA: anterior spinal artery. B. Non-regression of both the PTA and of a segment of the LLNA may explain our PTA variant resulting in a PTA directly feeding PICA hemispheric branch.

Persistent trigeminal artery variants are usually small in caliber, that may make their visualization and recognition difficult. This anomalous arteries are usually found incidentally but can be associated with a wide variety of anomalies in the cerebral vasculature: hypoplastic or agenetic vessels (carotid or vertebral artery), intracranial aneurysm or carotid-cavernous fistula [6,8,9] and may be responsible for ischemia and trigeminal neuralgia. Neuroradiologists, as well as neurosurgeons, have to know and recognize these rare variations because their unawareness may be responsible for vascular wound during surgery (intrasellar location) or uncontrolled embolic agent migration during embolization.

Disclosure of interest

The authors declare that they have no conflicts of interest concerning this article.

References


