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NEURO-IMAGES

Duplication of the posterior cerebral artery: two case reports

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Introduction

The anatomy of the brain circulation is complex and variable. Autopsy studies and imaging techniques have detected anatomical variations of cerebral arteries (CAs) in 48–58% of the general population [1]. The duplication of the posterior cerebral artery (PCA) is a rare anatomic variant with a frequency of 2.3% [2, 3]. PCA duplication is characterised by the identification of a "true foetal" PCA, that originates from the internal carotid artery (ICA) and gives rise to the parieto-occipital artery, the internal occipital artery, the calcarine artery and the posterior pericallosal artery, associated with a PCA, that regularly arises from the basilar artery and gives rise to the posterior temporal artery [4].

Case presentation

Case 1

An 18-year-old girl presented to our institution for migraine without aura; magnetic resonance imaging (MRI) and a 3D time of flight (TOF) Magnetic resonance angiography (MRA) were performed.

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MRA (Fig. 1) revealed, on the left side, a hypoplastic P2 segment and an additional artery arising from the supraclinoid ICA, a hyperplastic anterior choroidal artery (AChorA).

Case 2

A 17-year-old girl from child neuropsychiatry unit, suffering from intellectual disability, came for unspecific headache. MRI exam including a 3D TOF MRA was performed. MRA (Fig. 2) revealed, on the left side, an artery arising from the supraclinoid ICA, a large persistent AChorA, associated with an ipsilateral PCA showing similar calibre. Moreover, MRA did not identify posterior communicating artery bilaterally.

Discussion

Vascular variants generally arise during foetal development [1]. At 5 weeks of gestation, the anterior brain circulation is constituted by two main branches of the ICA: the rostral branch (rICA) and the caudal branch (cICA). Most commonly the middle cerebral artery (MCA) and the PCA predominantly develop and take over the previously dominant AChorAs which regress (usually do not completely disappear); the cICA also regresses becoming the posterior communicating artery (PCoA) (it may also completely disappear) (Scheme 1) [5].

The failure to regress of foetal arteries gives rise to various anatomic variants; a rare anatomic variant is the so-called "true foetal PCA" due to the coexistence of a persistent a large primitive AChorA with a PCA regularly arising from the basilar trunk, as in our cases (Scheme 2) [2, 4, 6].

CAs may show a wide range of anatomic variants that present none or nonspecific symptoms and that can be incidentally discovered only during imaging as in our patients. To assess CAs, MRA is often performed first given its non-invasiveness and safety.

The significance of PCA duplication is in the stroke pattern, as the true foetal PCA is, therefore, part of the anterior

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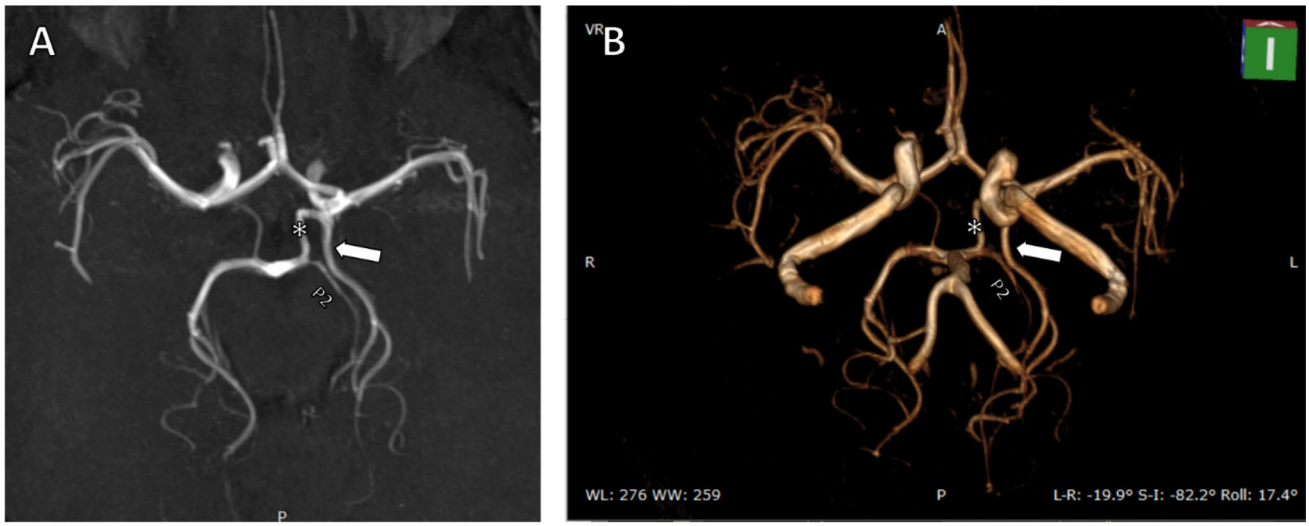


Fig. 1 Duplication of the left posterior cerebral artery. **a** Axial view of maximum intensity projection (MIP) and **b** inferior view of volume rendering (VR) reconstruction of 3D time of flight (TOF) magnetic resonance angiography (MRA) showing the presence of posterior communicating artery (asterisk) associated with hypoplastic left P2 segment and the presence of a hyperplastic anterior choroidal artery (arrow)

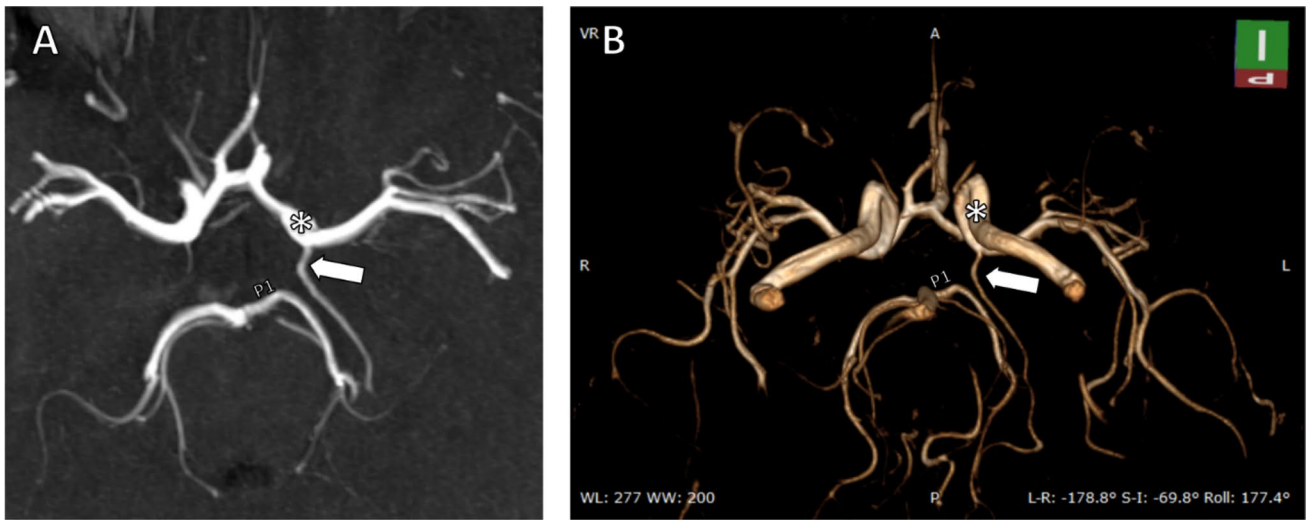
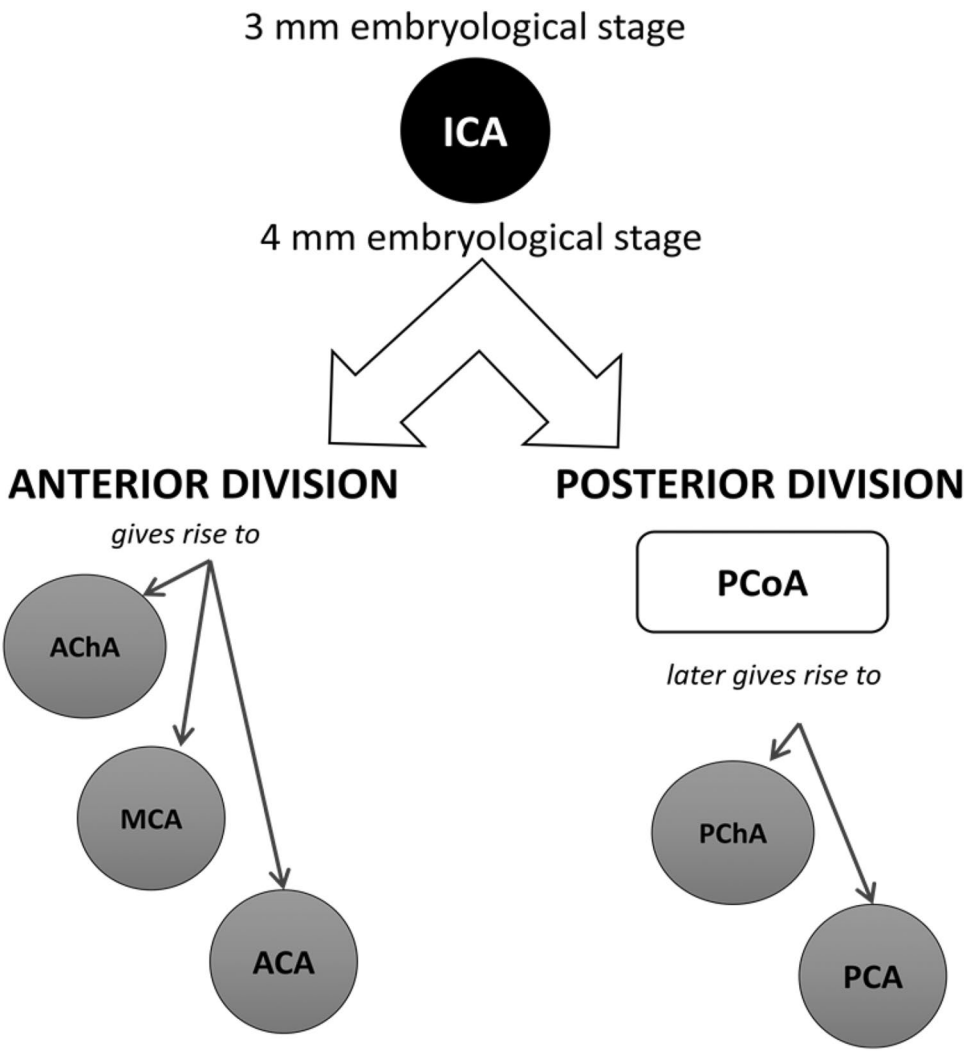


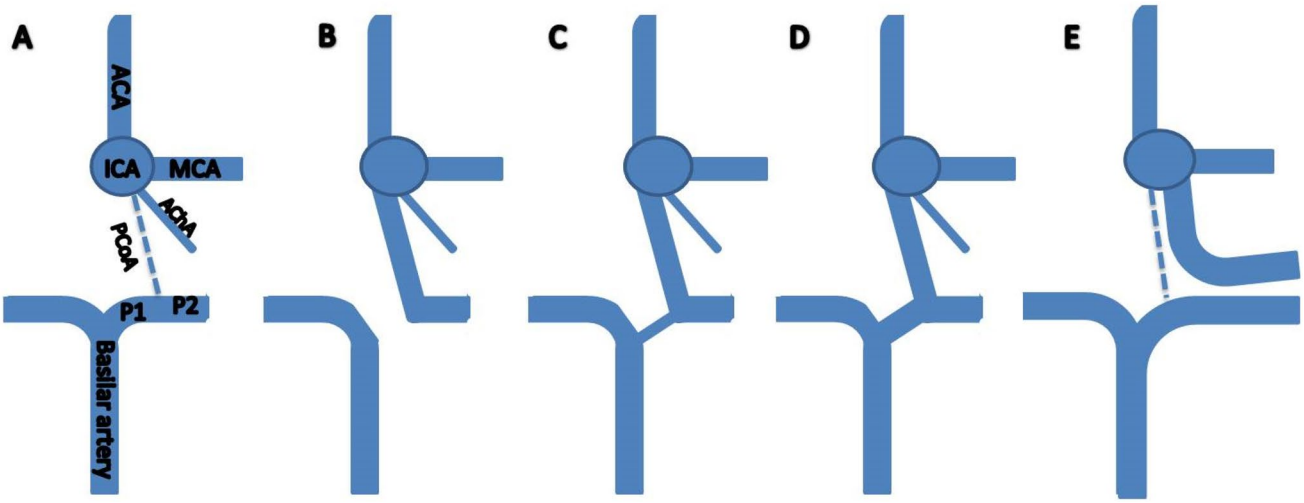
Fig. 2 Duplication of the left posterior cerebral artery. **a** Axial view of maximum intensity projection (MIP) and **b** inferior view of volume rendering (VR) reconstruction of 3D time of flight (TOF) magnetic resonance angiography (MRA) showing no communication between P1 segment and carotid siphon (asterisk) in association with the presence of a hyperplastic anterior choroidal artery (arrow)

circulation: a thromboembolism in ICA branches may result in paradoxical PCA territory infarction; while the coexistence of a PCA (with P1 present) allows for collateral circulation.

In conclusion, the knowledge and identification of cerebral arteries anatomic variants are important to evaluate correctly the distribution of brain ischemia and for the planning of surgical or endovascular treatment in patients with cerebrovascular diseases.



Scheme 1 Embryological development. The internal carotid artery (ICA) appears during the 3 mm embryonic stage. At 4 mm stage, the ICA branches off into the anterior and the posterior division. The anterior division will give rise to the anterior choroidal artery (AChorA), the middle cerebral artery (MCA), and the anterior cerebral artery (ACA); while, the posterior division will produce the posterior communicating artery (PCoA), which may regress, and later the posterior choroidal artery (PChorA) and the posterior cerebral artery (PCA)



Scheme 2 PCA variants. **a** Normal vascular anatomy of posterior cerebral artery (PCA). Depending on the calibre of P1 segment we can observe: "full foetal PCA". **b** When P1 segment is not visible; "partial foetal PCA". **c** when P1 segment appears smaller than the ipsilateral, posterior communicating artery (PCoA); "intermediate foetal PCA". **d** when P1 segment and the PCoA show the same calibre; **e** "true foetal PCA" when there are two independent PCAs: one regularly arising from the basilar trunk and the second deriving from the persistence of anterior choroidal artery (AChorA) with or without a visible PcoA. Anterior cerebral artery (ACA), middle cerebral artery (MCA), internal cerebral artery (ICA)

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Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest. The manuscript has not been published before and is not under consideration for publication anywhere else. Publication is approved by all authors and, tacitly, by the responsible authorities where the work was carried out.

Ethics approval The authors certify that they comply with the Principles of Ethical Publishing.

Informed consent Informed consent was obtained from the parents of the patients included in the study.

Consent for publication Patient's parents gave their approval during informed consent, when they were explained that, being in a university hospital, the exam would eventually be used for scientific purposes.

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