Research Square

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Bilateral accessory posterior cerebral arteries (hyperplastic anterior choroidal arteries): a case diagnosed by magnetic resonance angiography

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Research Article

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Abstract

Purpose

To describe a case of bilateral accessory posterior cerebral arteries (PCAs) incidentally diagnosed by magnetic resonance angiography (MRA).

Methods

A 33-year-old woman with a pituitary microadenoma underwent MRA using a 3-Tesla scanner. MRA was performed using a standard three-dimensional time-of-flight technique.

Results

MRA of the intracranial region revealed no pathological lesions. The right anterior choroidal artery (AChA) was hyperplastic and supplied the temporal branch of the right PCA. The left AChA was also slightly hyperplastic and supplied the hypertrophic uncal branch covering the anterior temporal branch of the left PCA.

Conclusion

A hyperplastic AChA that supplies a branch of the PCA is termed an accessory PCA, and three types have been described. When the entire PCA territory is supplied by a hyperplastic AChA, the artery is termed a replaced PCA. The prevalence of a hyperplastic AChA has been reported to be 2.3% on catheter angiography and 0.55% on MRA. However, to our knowledge, a type 1 accessory PCA, which supplies a hypertrophic uncal branch covering the anterior temporal branch of the PCA, has not previously been reported on MRA, and bilateral accessory PCAs have not been reported in the English-language literature. Because of the relatively low spatial resolution of MRA, small arteries such as a type 1 accessory PCA may be easily overlooked. Because numerous arteries are located around the circle of Willis, careful evaluation of volume-rendered MRA images is important for the accurate diagnosis of this vascular variation.

Introduction

The anterior choroidal artery (AChA) is rarely hyperplastic and supplies one or more branches, or the entire distribution, of the posterior cerebral artery (PCA). Its prevalence on catheter angiography and magnetic resonance angiography (MRA) has been reported to be 2.3% and 0.55%, respectively [7, 12]. Using catheter angiography, Takahashi et al. [7] classified hyperplastic AChAs into four types: type 1, a hypertrophic uncal branch covering the anterior temporal branch of the PCA; type 2, an anomalous temporal artery supplying the distribution area of the anterior and posterior temporal branches of the

PCA; type 3, an anomalous occipitoparietal artery supplying the distribution area of the calcarine and occipitoparietal arteries; and type 4, an anomalous temporo-occipito-parietal artery that completely replaces the original PCA. The first author previously proposed that types 1, 2, and 3 be termed accessory PCAs and type 4 a replaced PCA [12].

We herein report a case of a right type 2 accessory PCA and a left type 1 accessory PCA incidentally diagnosed by MRA. To our knowledge, no similar case has been reported in the relevant English-language literature.

Case report

A 33-year-old woman with a 5-year history of a pituitary microadenoma underwent cranial magnetic resonance imaging (MRI) and MRA for follow-up of the pituitary tumor and evaluation of the circle of Willis. MRI and MRA were performed using a 3-T scanner (MAGNETOM Skyra; Siemens Healthineers, Erlangen, Germany). MRA was performed using a standard three-dimensional time-of-flight technique. The imaging parameters were as follows: flip angle, 15°; repetition time, 38.0 ms; echo time, 3.7 ms; slice thickness, 0.5 mm; number of slices, 190; slab thickness, 95 mm; and field of view, 21.9 × 15.6 cm.

The pituitary microadenoma showed no interval change. Volume-rendered (VR) images of the MRA revealed no pathological lesions. The right AChA was hyperplastic and supplied the temporal branch of the right PCA, consistent with a type 2 accessory PCA. The left AChA was slightly hyperplastic and supplied the hypertrophic uncal branch covering the anterior temporal branch of the left PCA, consistent with a type 1 accessory PCA. Bilateral small posterior communicating arteries (PCoAs) were observed, and the bilateral PCAs were mainly supplied by the basilar artery (BA) (Fig. 1). After partial maximum-intensity-projection (MIP) images were created, the bilateral accessory PCAs were clearly demonstrated (Fig. 2).

No further imaging studies, such as computed tomography angiography (CTA) or catheter angiography, were performed. The patient was managed conservatively, and her clinical course was uneventful.

Discussion

According to the catheter angiographic study of hyperplastic AChAs by Takahashi et al. [7], type 1 accounted for 20%, type 2 for 60%, type 3 for 8%, and type 4 for 12% of cases. The overall prevalence of hyperplastic AChAs on catheter angiography was reported to be 2.3%. Using a 3-T MR scanner, the first author previously reported that the overall prevalence of hyperplastic AChAs was 0.55%, with type 2 accounting for 85% and type 4 for 15% of cases [12]. Type 1 hyperplastic AChAs are relatively small and may therefore be easily overlooked on MRA because of its limited spatial resolution. Because numerous arteries are located around the circle of Willis, careful observation of VR MRA images is important for the accurate diagnosis of this vascular variation (Fig. 1). Creation of partial MIP images is also useful for identifying small vascular variations (Fig. 2).

As mentioned in the **Introduction**, the first author previously proposed that types 1, 2, and 3 be termed accessory PCAs and type 4 a replaced PCA [12]. Among accessory PCAs, type 2 is the most prevalent [5, 7, 12, 14]. Type 3 accessory PCA has also been reported on MRA [8, 9, 13] and CTA [6]. Type 4 cases have rarely been reported using the term “replaced PCA” [3, 11]. In the present patient, the left type 1 accessory PCA was initially diagnosed by MRA. The patient also had a right type 2 accessory PCA. To our knowledge, no cases of bilateral accessory PCAs have been reported.

Embryologically, cerebral arterial variations are thought to result from failures of fusion and/or regression during early gestation. A hyperplastic PCoA that mainly supplies the distal PCA is referred to as a fetal-type PCA. Using CTA, Davidoiu et al. [2] reported that a unilateral fetal-type PCA was present in 10 of 139 (7.2%) patients, whereas bilateral fetal-type PCAs were present in 3 of 139 (2.2%) patients. If the P1 segment of the PCA is absent, the PCA is regarded as a complete fetal-type PCA. In contrast, if the P1 segment is hypoplastic, the PCA is regarded as a partial fetal-type PCA. However, in a “**true** fetal-type PCA,” the primitive anterior choroidal artery persists into adulthood despite the development of a second posterior circulation artery arising from the basilar trunk [1]. Therefore, a replaced PCA can be regarded as a complete **true** fetal-type PCA, whereas an accessory PCA can be regarded as a partial **true** fetal-type PCA.

In cases of an accessory PCA, there is usually no artery arising from the ICA distal to the anomalous artery, whereas a PCoA or a remnant of the PCoA is present at the ICA proximal to the anomalous artery. Endo et al. [4] reported a case of a duplicated AChA, in which the proximally originating artery was a type 2 accessory PCA. The first author has reported two cases of accessory PCA–PCA anastomosis [8, 13]. Accessory PCA is rarely associated with other arterial variations, such as an accessory middle cerebral artery (MCA) [10], a duplicated origin of the MCA and an accessory anterior cerebral artery [9], and a left vertebral artery arising from the descending aorta [1].

An aneurysm at the ICA–AChA junction is rarer than an aneurysm at the ICA–PCoA junction. Uno et al. [14] reported that, among 61 patients with ICA–AChA junction aneurysms, three had aneurysms at the ICA–hyperplastic AChA junction. Although the clinical significance of an accessory PCA remains unclear, the incidence of aneurysm formation at the ICA–hyperplastic AChA junction may be higher than that at the ICA–normal AChA junction. Several potential anastomoses between an accessory PCA and the PCA have been reported [5, 8, 13]. Therefore, in the event of occlusion of the proximal segment of an accessory PCA or the PCA, another artery may provide collateral circulation.

Conclusions

Using MRA, we diagnosed a case of bilateral accessory PCAs. The left accessory PCA was type 1 and was relatively small. To our knowledge, type 1 accessory PCA has not previously been reported on MRA, and bilateral accessory PCAs have not been reported in the relevant English-language literature. Because of the limited spatial resolution of MRA, a type 1 accessory PCA may be easily overlooked. Because

numerous arteries are located around the circle of Willis, careful observation of VR MRA images is important for the accurate diagnosis of this vascular variation.

Declarations

Author contributions AU carried out the study design and drafted the manuscript. AU and NT reviewed the manuscript critically, and have read and approved the final manuscript.

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Data availability Not applicable.

Conflict of interest The authors declare no competing interests.

Ethical approval and consent to participate All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Consent for publication The patient signed informed consent regarding publishing his data and figures.

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Figures

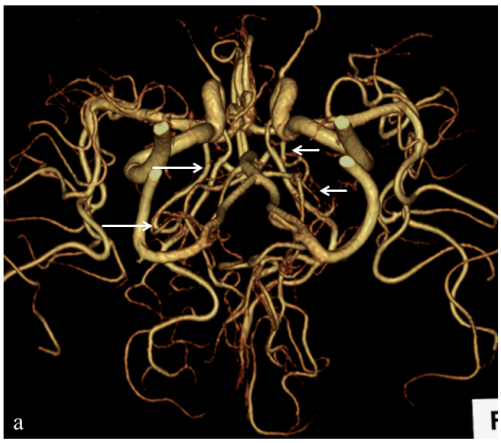


Fig. 1a

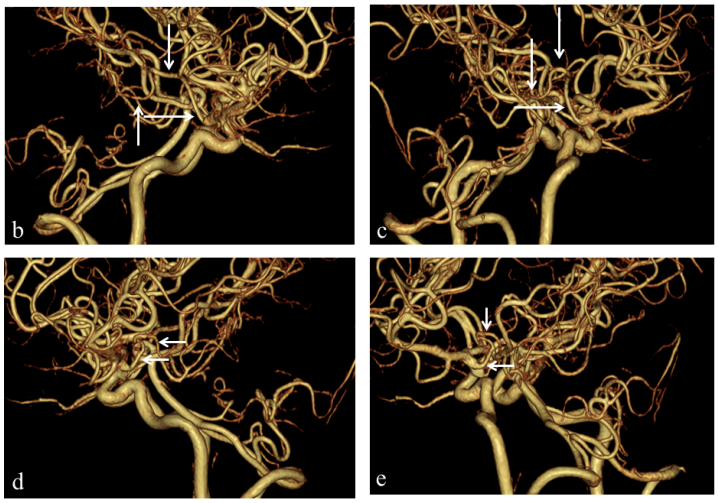


Fig. 1b-e

Figure 1

Inferosuperior (**a**), right lateral (**b**), right posterior oblique (**c**), left lateral (**d**), and left posterior oblique (**e**) projections of volume-rendered (VR) images of magnetic resonance angiography (MRA).

The right anterior choroidal artery (AChA) is hyperplastic and supplies the temporal branch of the right posterior cerebral artery (PCA) (*long arrows*). The left AChA is slightly hyperplastic and supplies the uncal branch of the left PCA (*short arrows*).

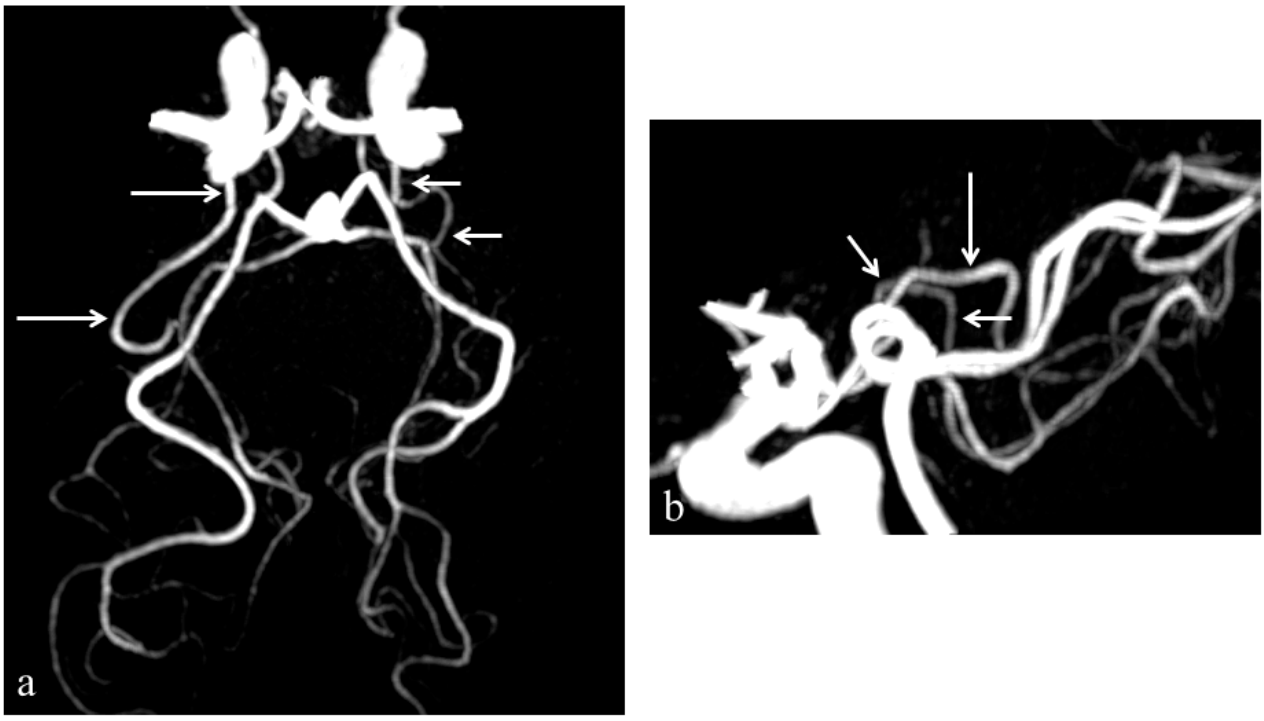


Fig. 2

Figure 2

Inferosuperior (**a**) and left lateral (**b**) projections of partial maximum-intensity-projection (MIP) images of the circle of Willis and PCA territories.

The right AChA is hyperplastic and supplies the temporal branch of the right PCA (*long arrows*), consistent with a type 2 accessory PCA. The left AChA is slightly hyperplastic and supplies the uncal branch of the left PCA (*short arrows*), consistent with a type 1 accessory PCA. Bilateral small posterior communicating arteries (PCoAs) are seen, and the bilateral PCAs are mainly supplied by the basilar artery.