Medial-type persistent trigeminal artery and ipsilateral posterior communicating artery supplying bilateral posterior cerebral arteries associated with an aberrant right subclavian artery and bicarotid trunk

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Research Article

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Abstract

Purpose

To describe a case of a medial-type persistent trigeminal artery (PTA) associated with multiple arterial variations.

Methods

A 34-year-old woman with multiple sclerosis underwent cranial magnetic resonance (MR) angiography from the aortic arch to the neck region and intracranial region for the evaluation of an unruptured cerebral aneurysm that was previously detected on MR imaging. The MR machine was a 3-T scanner.

Results

There was an aberrant right subclavian artery and bicarotid trunk, medial-type left PTA and ipsilateral posterior communicating artery (PCoA) supplying bilateral posterior cerebral arteries (PCAs). The unruptured aneurysm was located at the paraclinoid segment of the left internal carotid artery and was treated successfully by coil embolization via a transfemoral approach.

Conclusion

Only 10% of PTAs are classified as the medial type. The association with hyperplastic ipsilateral PCoA, which supplies the bilateral PCAs, has not been previously reported. Aberrant right subclavian arteries are common and are frequently associated with a bicarotid trunk. Before catheterization of the cerebral arteries, the aortic arch and its branches must be evaluated by MR angiography or computed tomography angiography to prevent catheterization failure via the right transradial approach.

Introduction

Persistent trigeminal artery (PTA) is the most cephalad and most common congenital carotid-vertebrobasilar anastomosis. Using magnetic resonance (MR) angiography, the prevalence of PTA, including PTA variants, is reported to be 0.68%. There are two types of PTA: lateral (usual) type and medial (intrasellar) type. The medial type is rare, with a reported prevalence of approximately 10% [5].

Aberrant right subclavian artery (RSA) is a common aortic arch branching variation. The prevalence of this variation on computed tomography (CT) angiography is reported to be 0.47%. Approximately one-third of cases are associated with a bicarotid trunk [12].
We herein report a case of medial-type PTA and ipsilateral posterior communicating artery (PCoA) supplying bilateral posterior cerebral arteries (PCAs) associated with an aberrant RSA and bicarotid trunk. No similar cases have been reported in the relevant English-language literature.

**Case report**

A 34-year-old woman with a 20-year history of multiple sclerosis underwent cranial MR angiography from the aortic arch to the neck region and intracranial region because a cerebral aneurysm was incidentally detected by cranial MR imaging during periodic follow-up examination of multiple sclerosis. The machine used was a 3-T scanner (Magnetom Skyra, Siemens Healthineers, Erlangen, Germany). MR angiography was obtained using a standard three-dimensional time-of-flight technique. The imaging parameters of the aortic arch and neck region were a flip angle (FA) of 18°, repetition time (TR) of 21.0 s, echo time (TE) of 3.7 s, and slice thickness of 1.2 mm. The imaging parameters of the intracranial region were an FA of 15°, TR of 20.0 s, TE of 3.7 s, and slice thickness of 0.6 mm.

MR angiography of the aortic arch and neck region showed an aberrant RSA and bicarotid trunk. The left common carotid artery (CCA) was much larger than the right CCA, and the bilateral vertebral arteries (VAs) were hypoplastic (Fig. 1). MR angiography of the intracranial region showed an unruptured aneurysm of the paraclinoid left internal carotid artery (ICA). A medial-type PTA arose from the cavernous left ICA. There was an extremely large left PCoA. The terminal segments of the bilateral VAs and proximal basilar artery (BA) were aplastic (Fig. 2). Partial volume rendering (VR) images of MR angiography (Fig. 3) and reformatted source images of MR angiography (Fig. 4) clearly showed the aneurysm, a medial-type left PTA supplying the distal basilar artery (BA) and bilateral superior cerebellar arteries (SCAs), and extremely large left PCoA supplying the bilateral PCAs. There was no connection between these two arteries, indicative of an absent terminal BA.

A paraclinoid left ICA unruptured aneurysm was successfully treated by coil embolization via a transfemoral approach. No recurrence was seen on follow-up MR angiography at 3 years after treatment.

**Discussion**

Traditionally, Salzman’s classification [8] was used for PTAs (Type 1, bilateral absence of the PCoAs; Type 2, bilateral absence of the P1 segment of the PCA [called fetal-origin PCA]; and Type 3, ipsilateral fetal origin of the PCA). Thus, our patient was regarded as having a Type 3 PTA. However, the ipsilateral P1 segment was also present in our patient because the contralateral PCA was also supplied by the fetal origin of the PCA. Weon et al. [13] proposed a modified classification, wherein the PTA is classified into five types; however, our patient could not be precisely classified by this classification. These classifications may be useful for the hemodynamic evaluation of the vertebrobasilar system. However, we believe that these classifications have no meaning with regard to the embryological development of the PTA [5].
Salas et al. [7] classified the PTA into two types according to its relationship to the abducens nerve, lateral and medial types. These two types of PTAs are suggested to have different embryonic development. The lateral type is the usual type, and approximately 90% of PTAs are classified as this type [2, 5, 11]. Medial-type PTAs are rare; however, Deniz et al. [1] recently reported that 3 of 7 PTAs were medial-type. The medial type runs in the pituitary fossa; thus, it is also called intrasellar PTA and is dangerous during transsphenoidal pituitary surgery. A medial-type PTA arises from a slightly more distal portion of the ICA than a lateral-type PTA [10].

In cases of large PTA, similar to our patient, the proximal BA is hypoplastic or aplastic [9]. Huang et al. [2] recently proposed a grading system that classifies the caliber ratio of the proximal BA/PTA into 6 grades. In the present case, the proximal BA/PTA was classified as grade 0 (BA aplasia). In our patient, the ipsilateral PCoA was hyperplastic and supplied bilateral PCAs; thus, the terminal segment of the BA was also aplastic. This unique configuration of the PCoA-PCA system has not been reported in the relevant English-language literature.

Aberrant RSA is the most common aortic arch branching variation that arises from the most distal segment of the aortic arch, and it is usually asymptomatic. Rare symptoms related to aberrant RSAs are dysphagia (arteria lusoria), dyspnea, and retrosternal pain [6]. According to a cadaveric study [4], 5 of 6 aberrant RSAs took a retroesophageal course, and the remaining one took an interesophageotracheal course. Aberrant RSAs are frequently associated with other cardiovascular malformations/variations [3]. In approximately 1/3 patients with an aberrant RSA, bilateral CCAs arise simultaneously from the aortic arch, forming a bicarotid trunk [12]. In patients with an aberrant RSA, because of the branching order, right transradial cerebral angiography cannot be performed. In our patient, an unruptured paraclinoid left ICA aneurysm was successfully treated by coil embolization via a transfemoral approach. Before catheterization of the cerebral arteries, the aortic arch and its branches must be evaluated by MR angiography or CT angiography to prevent catheterization failure via the right transradial approach.

Conclusions

We reported a case of medial-type left PTA that was associated with ipsilateral PCoA supplying bilateral PCAs. An aberrant RSA associated with a bicarotid trunk was also present, and an unruptured left ICA aneurysm was successfully treated by coil embolization via a transfemoral approach. Before catheterization of the cerebral arteries, the aortic arch and its branches must be evaluated by MR angiography or CT angiography to prevent catheterization failure via the right transradial approach.

Declarations

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

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Data availability Not applicable.

Declarations

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 her data and figures.

References


**Figures**

**Fig. 1**

[Image of an anatomical figure showing an aberrant right subclavian artery (long arrow) and another anatomical feature.]

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**Figure 1**

Left anterior oblique projection of the volume-rendering (VR) image of magnetic resonance (MR) angiography from the aortic arch to the neck shows an aberrant right subclavian artery (*long arrow*) and
bicarotid trunk (*short arrow*). The left common carotid artery (CCA) is much larger than the right CCA, and the bilateral vertebral arteries (VAs) are hypoplastic.

Figure 2

Anteroposterior (a) and left lateral (b) projections of the VR image of cranial MR angiography show a nonruptured aneurysm of the paraclinoid left internal carotid artery (ICA) (*long arrow*). A persistent trigeminal artery (PTA) arises from the cavernous left ICA and runs medially, indicative of the medial type (*short arrow*). An extremely large left posterior communicating artery (PCoA) that supplies the bilateral posterior cerebral arteries (PCAs) is seen (*thick short arrow*). The terminal segments of the bilateral vertebral arteries (VAs) and proximal basilar artery (BA) are aplastic (*thick long arrows*).
Infero-superior (a) and supero-inferior (b) projections of partial VR MR angiography images clearly show a paraclinoid left ICA aneurysm (*long arrows*), a medial-type left PTA supplying the distal BA and bilateral superior cerebellar arteries (SCAs) (*short arrow*), and an extremely large left PCoA supplying the bilateral PCAs (*thick short arrow*). There is no connection between these two arteries, indicative of an absent terminal BA.
Reformatted source images of MR angiography at 5 mm thickness (a, b) clearly demonstrate a medial-type left PTA supplying the distal BA and bilateral SCAs (short arrow), a paraclinoid left ICA aneurysm (long arrows), and an extremely large left PCoA supplying the bilateral PCAs (thick short arrow). There is no connection between these two arteries, indicative of an absent terminal BA.