MRA 12,056例に基づく脳血管の変異の神経放射線学的評価

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Introduction

As identification of vascular variants is very important in clinical neuroradiology[1,2,5,16], we examined the magnetic resonance (MR) angiographic incidence, location, and characteristic configuration of vascular variants and associated vascular disease.

Material and methods

Patients: Between April 2004 and September 2007, a total of 12,056 consecutive cranial MR angiographies were performed at our institution, consisting of 5,831 (48.4%) females and 6,225 (51.6%) males, with a mean age at examination of 61.8±14.5 (mean ±S.D.) years (range 0–95 years). In this series, there were 2,403 cases of asymptomatic patients for brain check including screening studies, 2,876 cases presented with headache but no remarkable neuroradiological abnormality, 2007 cases with vertigo and/or tinnitus without neuroradiological findings and 4,291 cases diagnosed as a stroke including asymptomatic lacuna infarction.

MRI and radiological findings: All patients were studied with three of 1.5 Tesla units (SIEMENS, Magnetome VISION and GE, Excite) and one of 1.0 Tesla unit (SIEMENS, Impact EXPERT). Majority of MR angiography was performed with either the multiple overlapping thin slab or conventional single slab acquisition technique (TR 32 mm sec. TE 6.9 mm sec. Mean acquisition time: 3 min 20 sec., field of view: 16×16 cm). In all cases, vertebrobasilar junction were included within the FOV (field of view). Reading and interpretation of these MRA studies were done by three neuroradiologists and one neurosurgeon. In 32 cases, BA fenestrations were also confirmed with 3D-helical CT angiography and 15 of these under went additional catheter cerebral angiography combined with 3D-rotation angiography.

Results

A total of 156 (88 males, 68 females) cases of BA fenestrations (1.29%) were detected in this series. With a mean age of 59.6±15.5 years (mean±S.D.) and mean diameter 2.4×1.3 mm (Fig. 1).

A total of 91 cases (0.75%) of anterior communicating (A. com) artery fenestration were detected (mean age 61.1±11.2 years). Three cases were associated with incidental unruptured anterior communicating artery aneurysm (Fig. 2).

A total of 82 cases (0.68%) of persistent primitive trigeminal artery (PPTA) were detected (Fig. 3). Among these, a total of 44 were PTA and 35 were persistent primitive trigeminal artery variant (PTAV). There were 3 cases of unclassified group. The distribution of laterality of PTA were right sided 39 cases and left sided 43 cases. Two cases presented with asymptomatic unruptured aneurysm. Vascular anomalies associated with PTA and PTAV were 4 cases of double middle cerebral artery, and 2 cases of fenestration of A2 portion of anterior cerebral artery.

A total of 45 cases (0.37%) of accessory middle cerebral artery were detected (Fig. 4). Among these, no marked intracranial aneurysm was identified.

There were 28 cases (0.23%) of anterior cerebral artery (A2 segment) azygos and 2 cases (0.01%) of middle cerebral artery fenestration (Fig. 5).

Associated vascular diseases

Aneurysm: A total of 113 cases (0.93%) of 12,056 cases had intracranial aneurysms. Among these, 28 cases had been diagnosed as intracranial aneurysms with the other modalities prior to this MR angio-

graphy; 11 cases (7%) of intracranial aneurysms from these 156 basilar trunk fenestration were detected. One presented a fusiforme aneurysm at V4 portion distal to PICA. Three had lower basilar trunk aneurysms associated with fenestration on MRA and those of them were confirmed with 3D helical CT. One case presented with intractable hemifacial spasm due to the invagination of the aneurysm into the brain stem originating from fenestration (Fig. 3). This patient underwent endovascular treatment with platinum coils and the hemifacial spasm was completely cured. In 3 cases, aneurysms were located in the anterior circulation territory that is separate from the basilar trunk fenestration.

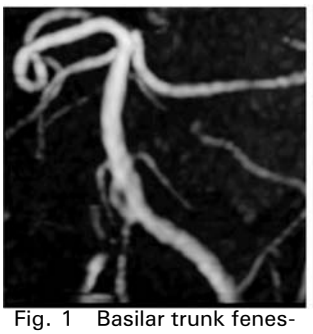

Fig. 1 Basilar trunk fenestration

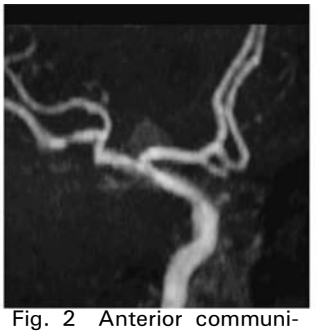

Fig. 2 Anterior communicating artery fenestration

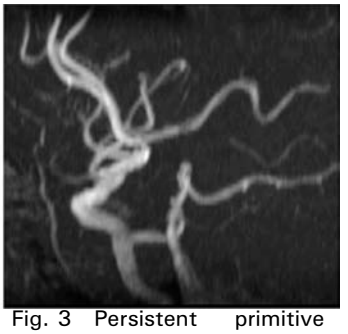

Fig. 3 Persistent primitive trigeminal artery

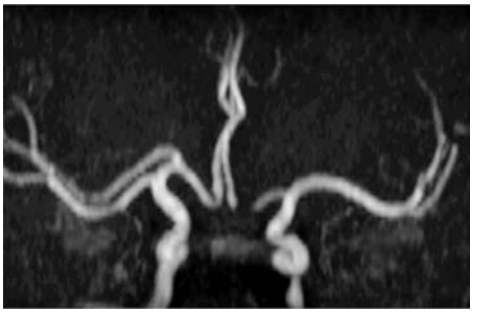

Fig. 4 Accessory MCA

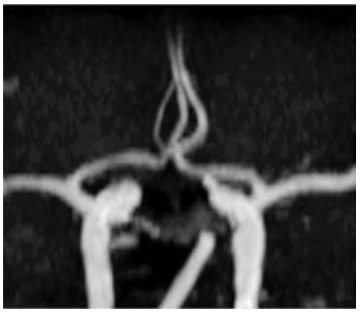

Fig. 5 Azygos of A2

Ischemia: Three cases of BA fenestration group had atherothrombotic infarction in the territory of vertebrobasilar system. One case presented Wallenberg syndrome, the second case had AICA territory infarction and the third case showed ipsilateral posterior cerebral cortical artery infarction.

Associated vascular variant: One asymptomatic case of BA fenestration was associated with anterior communicating artery fenestration (A1A2 junction). Another asymptomatic case of BA fenestration was accompanied with persistent primitive trigeminal artery. Among the total 12,056 cases, 9 cases (0.39%) had persistent primitive trigeminal artery and 4 cases (0.18%) presented with anterior communicating artery fenestration.

Discussion

Basilar artery embryology and fenestration: The word fenestration refers to a localized or segmental duplication equal to an unfused vessel[5~9,16]. As well described by Padget, the basilar artery develops from paired primitive longitudinal neural arteries that are formed in the 4–5 mm embryo during its first stage of development[3]. These vessels run longitudinally along the ventral portion of the hindbrain (rhombencephalon) and form focal connections with each other across the midline. During the second stage of development, at 5 weeks' gestation, fusion of the channels gradually starts to form the basilar artery. When the paired longitudinal neural arteries fail to fuse, fenestration may occur anywhere along the course of the basilar artery[5,7,33]. In the literature, the most frequent site of basilar artery fenestration is in the proximal portion[5,12~16]. The middle or distal part of the basilar artery is rarely affected. These data are well corresponded to our current results.

Frequency of fenestration: The natural incidence of fenestration of the basilar artery is difficult to define, and the data vary according to type of series and modalities of detection. Pathologic frequency based on autopsy series varies from 1.3% to 5.3%[16], while angiographic frequency varies from 0.022% to 1.7%[5,6,8,14~16]. High resolution MRA and stereoscopic observation can delineate such a small fenestration despite the complex configuration.

Aneurysm associated with fenestration: Finlay and Canham[17] reported that the lateral walls of the fenestrated artery have a normal intrinsic architecture. The media is absent locally, with discontinuity of elastin at the proximal end of the fenestration. The

subendothelium is thick distally and thin proximally. This characteristic of the luminal architecture explains the formation of aneurysm associated with fenestration. In our series, one case showed the aneurysm located in the distal end of the fenestrated trunk. In the recent literature, there is an increasing number of reports emphasizing that the endovascular approach may represent a suitable treatment for aneurysms associated with fenestration[8~10,14~17].

Conclusion

The current study showed that the vertebro-basilar junction should be included in the imaging slices of routine MR angiography, due to its high association with saccular aneurysms as well as ischemic disease.

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Neuroradiological evaluation of vascular variants based on 12,056 cases of cerebral MRA

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Purpose: An anatomical variant is one of the expressions from the embryological development of vasculature. We analyzed the incidence of vascular variants and the association of intracranial aneurysms based on 12,056 consecutive cases of MRA in clinical patients.
Methods and material: From 2004 to 2007, a total of 12,056 cases of MRA (3D–TOF) were performed. The incidence of variants (e.g. fenestrations, duplication, primitive persistent artery) was studied in association with the incidence of intracranial aneurysm.
Results: In this series, 156 cases (1.29%) of basilar trunk fenestration, 91 cases (0.75%) of anterior communicating artery fenestration, 82 cases (0.68%) of persistent primitive trigeminal artery, 45 cases (0.37%) of middle cerebral artery duplication, 28 cases (0.23%) of azygos A2, 2 cases (0.01%)of middle cerebral artery fenestration were depicted. A total of 11 cases from 156 cases of basilar trunk fenestration presented incidental unruptured aneurysm. The 3D–reconstruction image with digital subtraction angiography and CT was effective to visualize the microanatomical structure of those variants.
Conclusion: Fenestration of the artery might be one cause of intracranial aneurysmal formation, however there was no significant relation between persistent artery and the incidence of aneurysm.

Key words: vascular variants, fenestration, MR angiography, persistent primitive artery