

Usefulness of Vessel Selective 4D-MR Angiography for Intracranial Arteriovenous Malformation

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Introduction

Intracranial arteriovenous malformation (AVM) is an abnormal formation of arteries and veins, and is one of important vascular disease in brain. For the assessment of intracranial AVM, information of feeding artery is very useful to determine treatment planning. Gold standard for detecting feeding artery is conventional digital subtraction angiography (DSA), however this method is too invasive. In recent years, time-resolved 4D-MRA technique based on arterial spin labeling (ASL) methods has been widely reported [1]. This technique enables the evaluation of arterial hemodynamics noninvasively. In addition, vessel selective 4D-MRA (VS 4D-MRA) can be obtained using spatial free labeling slab based on pulsed ASL technique [2]. The aim of this study was to assess the usefulness of VS 4D-MRA for the assessment of feeding artery in intracranial AVM.

Methods

Fifteen segments of arterial territory in five patients with intracranial AVM were studied. MR imaging with VS 4D-MRA was performed in all fifteen segments. All MR scanning was performed by using a 3.0-Tesla unit (Achieva TX; Philips Medical Systems, Bests, the Netherlands) with 8-channel head coil. Tagging scheme of EPI-STAR was used for the labeling. Free labeling slab was placed to divide 3 segments of right common carotid artery, left common carotid artery and vertebral / basilar artery (Figure1).

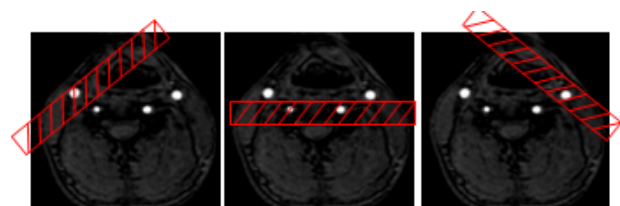


Figure 1; segmentation of right common carotid artery, vertebral-basilar artery, and left common carotid artery using spatial free labeling slab.

The parameter of VS 4D-MRA is as follows; FOV=230mm, Matrix=192 x 192, slice thickness=0.9 mm, 160 slices, TE/TR=5/13 ms, EPI factor=5, TFE factor=13, flip angle=10-degree, cycle duration=1900 ms, phase interval=212ms, Readout 3D segmented T1-TFEPI sequence, Scan time=3'51. Three dimensional TOF-MRA was also acquired for the comparison to VS 4D-MRA. From imaging findings of VS 4D-MRA and 3D TOF-MRA, image evaluations were performed about these points; 1) to obtain the vessel selectivity, 2) to detect feeding arteries, 3) (if multi feeding artery was observed) to detect which one is main feeding artery to shunt flow, respectively. Image evaluation was performed by one board certified neuroradiologist with nine years experience. Confirmation of these findings was performed by DSA findings.

Result

VS 4D-MRA scan was successfully performed in all patients, however, vessel selectivity was obtained not in all segments (12 of successful selectivity of total 15 segments). Total 10 feeding arteries in all patients were detected by DSA. All feeding artery was successfully observed in VS 4D-MRA, on the other hands, 3D TOF-MRA failed to detect one of total ten arteries (Figure 2). Three cases had multi-feeding arteries to shunt flow. Main feeding artery was successfully detected by VS 4D-MRA in all 3 cases, however, 3D TOF-MRA failed to detect one case of main feeding artery.

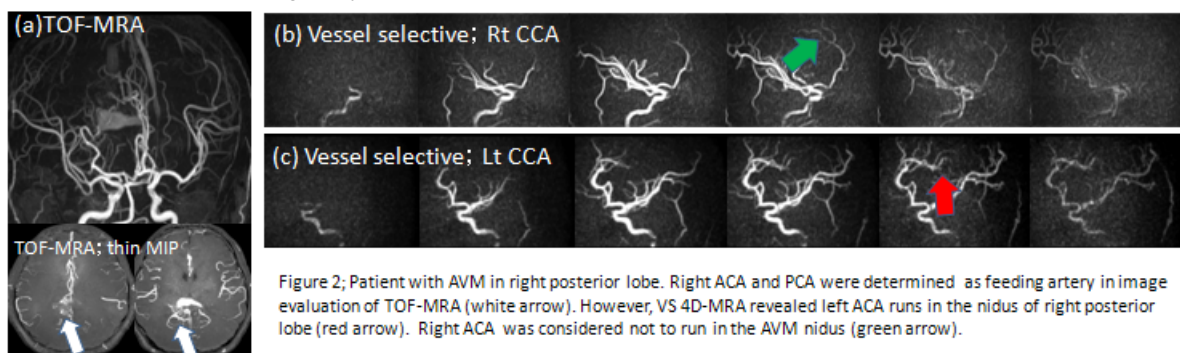


Figure 2; Patient with AVM in right posterior lobe. Right ACA and PCA were determined as feeding artery in image evaluation of TOF-MRA (white arrow). However, VS 4D-MRA revealed left ACA runs in the nidus of right posterior lobe (red arrow). Right ACA was considered not to run in the AVM nidus (green arrow).

Discussion and Conclusion

Compared to conventional TOF-MRA, additional information of feeding arterial flow was obtained using VS 4D-MRA. This technique can be useful for the evaluation of intracranial AVM as additional information.

References

[1] Bi et al., Magn. Reson. in Med. 63:835-841 (2010); [2] Nakamura M, et al., Radiol Phys Technol. 2013 Jul;6(2):327-34.