Non-contrast Dynamic MRA using TrueFISP based Spin Tagging with Alternating Radiofrequency (TrueSTAR) in Cerebral Arteriovenous Malformation

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Introduction

Cerebral arteriovenous malformations (AVMs) are congenital vascular abnormalities consisting of direct arteriovenous shunts without a normal intervening capillary bed. AVMs are responsible for a significant proportion of the intracranial hemorrhages and confer significant morbility and mortality[1]. A detailed characterization of angioarchitecture and hemodynamics, such as exact location, dimensions of the nidus, arterial feeding, and draining veins, is required for adequate diagnosis and treatment of AVMs. Intra-arterial digital subtraction angiography (DSA) is considered the gold standard but is invasive. Contrast-enhanced dynamic MR angiography (CE-dMRA) is a promising technique but has concerns for contrast induced nephropathy. The temporal resolution of CE-dMRA is also generally on the order of seconds. We have recently proposed a non-contrast dynamic MRA (dMRA) technique termed TrueFISP based Spin Tagging with Alternating Radiofrequency (TrueSTAR)[2]. The purpose of this study is to explore the feasibility and clinical value of dMRA using TrueSTAR in a prospective series of AVM patients.

Methods

Five patients with AVMs (3 male, 2 female, age 36 ± 9 years old) were included in this study. All patients underwent MR examination on 3T Siemens Tim Trio scanner with 12-channel phased-array head coil. The TrueSTAR technique combines arterial spin tagging with a cine 3-D segmented multiphase TrueFISP sequence. FAIR[3] was used for spin tagging in this study. After selective or non-selective inversion pulses, the signal was continuously acquired by a segmented multi-phase TrueFISP readout. Dynamic MRA image series were generated by complex subtraction of selective and non-selective inversion recovery acquisitions. Imaging parameters were: FOV=220mm, Matrix=256×256, 10-36 slices with 1.5-4mm thickness, flip angle 30°, TR=4ms, TE=TR/2, rate-2 GRAPPA, 20-30 phases with temporal resolution of 80-100ms, scan time 7-10min. Conventional MR sequences included axial T1, T2 and Time-of-Flight (TOF) MRA (TR/TE= 33/3.86, 0.57×0.57×0.65mm^{3}resolution). Dynamic MRA images were reviewed with respect to image quality, artifacts, and compared with TOF MRA regarding detailed vascular abnormalities.

Results

Dynamic MRA was successfully performed in all patients. The results are in general compatible with TOF MRA results (Fig.1). Dynamic MRA demonstrated the nidus as well as the dynamic time course of feeding arteries and draining veins that can be seen in TOF MRA (in case D, E). Furthermore, dMRA offers temporal information on the passage of labeled blood allowing clear temporal separation of the feeding arteries from draining veins that are otherwise difficult to differentiate in TOF MRA (in case A, B, C). Although the spatial resolution of dMRA (1x1mm^2 in-plane, 1.5-4mm through-plane) is lower than TOF, the high temporal resolution (≤100ms) provides complementary information of static TOF MRA.

Conclusion

We demonstrated the feasibility for visualizing the dynamic filling of feeding arteries, nidus and draining veins of AVM lesions without contrast agent using TrueSTAR. In combination with the high static spatial resolution of TOF MRA, the high temporal resolution of TrueSTAR dMRA may provide complementary information in the clinical evaluation of AVMs as well as stenosis and aneurysm.

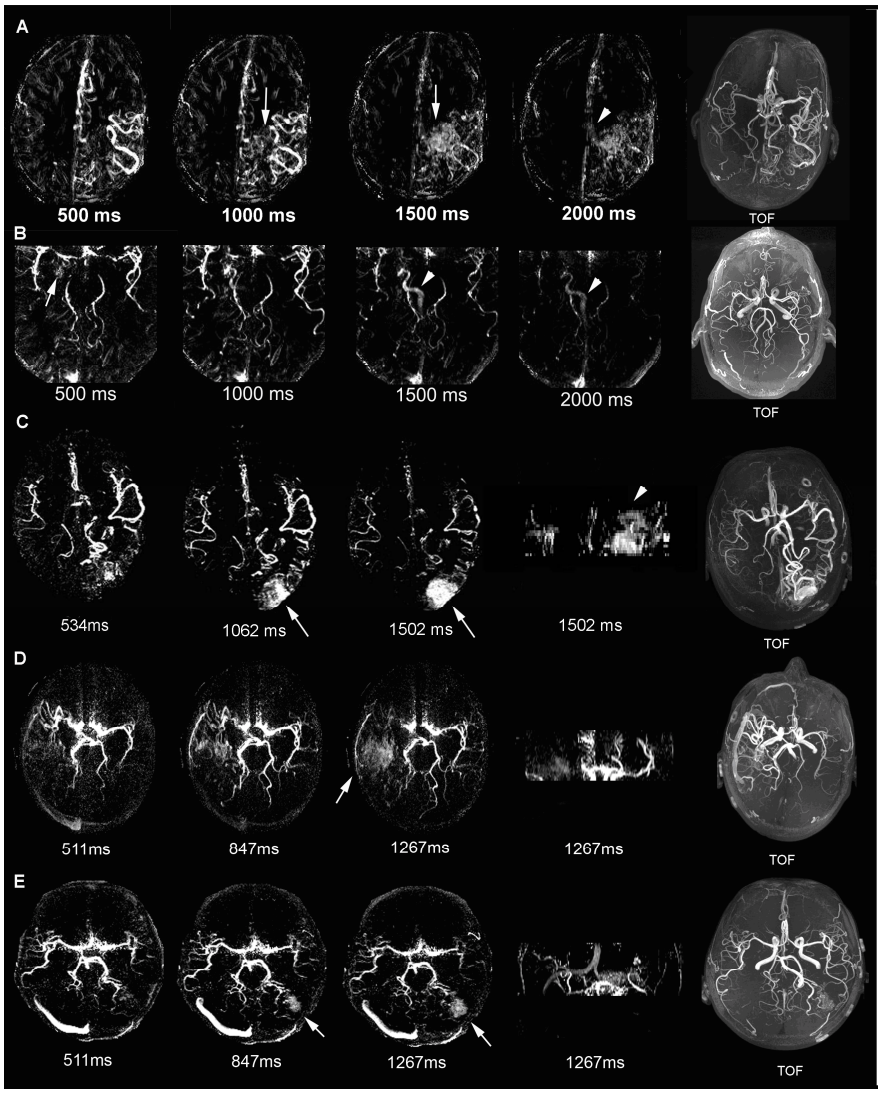

Fig. 1 Dynamic MRA and TOF images in five cases with arteriovenous malformations (AVMs). Arrow and arrowhead indicate nidus and draining vein respectively.

References

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