The role of 4D MRA with keyhole and view-sharing at 3.0T in the diagnostic work-up of cerebral arteriovenous malformations: a prospective intra-individual study

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Aim of the study

To compare highly accelerated time-resolved magnetic resonance angiography with sub-second temporal resolution and whole head coverage in the pre- and postoperative evaluation of cerebral arterialvenous malformations (cAVM) with digital subtraction angiography (DSA).

Introduction

Time resolved MRA is a promising technique in the diagnostic assessment of many supraaortic vascular pathologies including the diagnosis and follow-up of cAVM; however, due to its limited spatial and temporal resolution as compared to DSA, it suffers from shortcomings in the detailed characterization of cAVM, especially with respect to hemodynamic considerations (1). Previous studies allowed for temporally accelerated imaging at preserved high spatial resolution by a combination of keyhole (2,3), CENTRA (4), parallel imaging (5), partial Fourier, and alternating view-sharing (6). The current study was carried out to compare high temporal resolution 4D MRA in the entire diagnostic work-up of cAVM including pre- and post-operative assessment.

Methods

38 consecutive patients with cAVM (23 women, 15 men; age: 40.6±13.8 (17–69) years) were included. All patients were examined on a 3.0 Tesla whole body MRI (Philips Achieva) and received both 4D MRA and digital subtractction angiography (DSA) examinations. 14/38 (37%) patients were operated and received 4D MRA and DSA both pre- and postoperatively. Contrast-enhanced 4D MRA was performed with keyhole, CENTRA, partial Fourier, parallel imaging and alternating view-sharing (temporal resolution, 572-608 ms; 50 dynamic acquisitions; spatial resolution, 1.1 x 1.1-1.4 x 1.1 mm³). 4D MRA and DSA images were independently reviewed by two readers with respect to Spetzler-Martin Classification (7), arterial feeders and operative occlusion of the cAVM.

Results

In 38 of 38 patients Spetzler-Martin classification of cAVM as determined by 4D MRA matched for both readers with DSA results (fig.1, Spetzler-Martin-Grades, I: 4, II: 20, III: 10, IV: 3, V: 1). 14/68 (20,6%) additional arterial feeders were identified by DSA. The evaluation of residual cAVM filling by 4D MRA and DSA matched in 14/14 patients: residual filling was excluded and complete resection of the cAVM was confirmed in the postoperative 4D MRA studies accordingly to DSA in 13/14 (92,9%) patients (fig. 2). Residual post-operative filling of cAVM was diagnosed in 1/14 (8,1%) patients and confirmed by DSA. In a re-operation the remaining nidus was confirmed and removed.

Conclusion

Highly accelerated 4D MRA matched with DSA in all patients regarding pre-operative Spetzler-Martin Classification and postoperative assessment of residual filling of cAVM and may be considered as a non-invasive alternative in the entire diagnostic work-up of patients with cAVM.
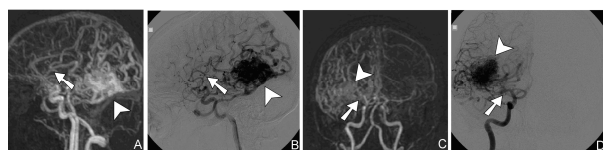

Fig. 1 Large right temporal cAVM in a 35 year-old female patient (arrowheads). 4D MRA and corresponding DSA accordingly revealed an arterial feeder from the right medial cerebral artery (arrows). Spetzler-Martin Grade III.
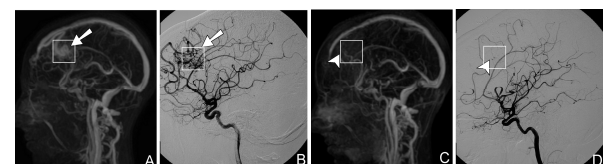

Fig. 2 Pre- (A,B) and postoperative (C,D) 4D MRA and DSA examinations in a 24 year-old female patient with resection of a left frontal cAVM (arrows, square), Spetzler-Martin Grade III.

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