Dynamic MRA: Imaging of intracranial vascular malformations before and after endovascular treatment - preliminary results

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INTRODUCTION

Time-resolved 2D MRA after injection of a contrast agent bolus has been used for carotid imaging (1,2). Similar to conventional cerebral i.a. DSA, 2D MR DSA offers the ability to observe the dilution of the bolus in the intracranial vascular system during the passage with a temporal resolution considerably below 1s (3,4). Images in 2D MR DSA have a low SNR. Therefore, the improvement of the SNR in 2D MR DSA for cranial application is indispensable.

Postprocessing of images in 2D MR DSA by correlation analysis offers several advantages with significant improvement of SNR of a factor of up to three, background suppression without subtraction and clear artery-vein separation even in brain vessels (5).

In this study, we present initial results on patients with brain arteriovenous malformations (AVM) and dural arteriovenous fistulae (DAVF) before and after embolization studied by time-resolved projection MRA in comparison to i.a. DSA.

MATERIAL AND METHODS

Four patients with intracranial vascular malformations (2 AVM, 2 DAVF) underwent diagnostic x-ray i.a. DSA and 2D MR DSA before and after partial or complete endovascular therapy.

All MR examinations were performed on a 1.5 T scanner (Magnetom Vision, Siemens, Germany) with a standard gradient system (25mT/m and 600μs risetime) using a head coil.

We used a snapshot FLASH optimized for projection imaging with a minimum TE of 1.5 ms/TR 4.3 ms and a slab thickness of 45mm. FOV was 250mm^2, resulting in an in-plane resolution of 0.98mm^2 for a matrix size of 256mm^2.

Rectangular FOV was used to speed up the temporal resolution. Single dose Gd-DTPA was supplied with an automatic injectior (volume 15 ml, flow rate 5 ml/s). Functional images were created by the use of correlation analysis to signal time courses representing the arterial and venous phase. The aquired time-resolved projection images together with the functional angiograms were compared with conventional i.a. DSA.

RESULTS

Fig.1 and Fig.2 summarizes the results of the analysis of 2D MR DSA. Fig.1 shows the results of the sequence on the brain AVM located in the central region before embolization with Ethibloc®. Notice the paralleled averaged time courses in the feeding artery and the draining vein.

The projection images correspond well with x-ray i.a. DSA in all cases, with respect to the in-plane resolution (0.98mm^2) and temporal resolution of 2 frames/s. The functional images allowed an artery-vein separation which is more clear in the slow flow DAVFs compared to the high flow AVMs investigated.

Notice the loss of arterio-venous communication after complete embolization of a DAVF filled from branches of the external carotid artery (Fig.2). The x-ray i.a. DSA before endovascular treatment as well as the functional images with an improved SNR generated by correlation analysis show most of the feeding arteries originating from the occipital, middlemeningeal and anterior auricular artery.

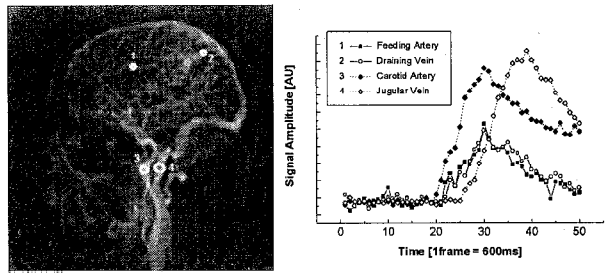

Fig.1: *Brain AVM: Averaged image with selected ROIs (left); corresponding signal time courses in the CCA, arterial feeder, the venous drainage as well as in the jugular vein on the right.*

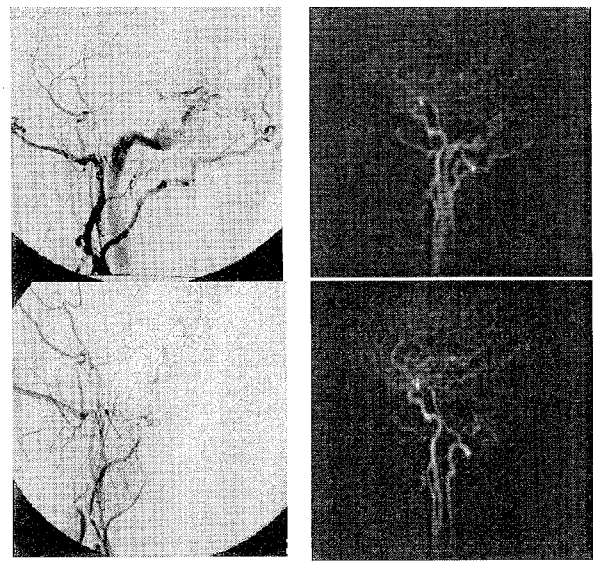

Fig.2: *DAVF: x-ray i.a.DSA (left side) before and after embolization: Complete occlusion of the fistula. Corresponding functional images representing the arterial phase generated by correlation analysis from projection 2D MR DSA (right side).*

DISCUSSION AND CONCLUSIONS

Our preliminary results indicate that imaging of intracranial vessels by the use of time-resolved projection MRA is technically feasible. Postprocessing of images in 2D MR DSA by correlation analysis offers several advantages with significant improvement of SNR and background suppression. In patients with AVMs and DAVFs the functional images of high diagnostic quality allowed a clear artery-vein separation due to the high temporal resolution with 2 frames/s .In respect to the limited temporal and spatial resolution of the sequence for clinical application further attempts are warranted to obtain an adequate resolution for detecting very small brain vessels e.g. in patients with brain AVMs.

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